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A NEW SPECIES OF FLEA FROM THE FIELD MOUSE, BAIOMYS TAYLORI

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Austin, Texas

A large series of an apparently new flea has been taken from the field mouse, *Baiomys taylori*, in Lavaca County, Texas, in connection with an extensive murine typhus research program being conducted there by the Texas State Department of Health and the United States Public Health Service. Considering the small size of the *Baiomys*, the mice were heavily infested with this flea. During March and April, 1946, eighty-one fleas were combed from twenty-one of these mice.

This new flea has been identified according to Ewing and Fox (2) as a member of the genus *Trichopsylla*, subgenus *Pleochaetis*. Augustson (1) recently described a new species of flea from *Peromyscus* mice taken at San Antonio, Texas, with similar generic characters to the species described in this paper. He erected the new genus *Pleochaetoides* to hold his species, *Pleochaetoides bullisi*. However, Ewing and Fox are followed here.

Dr. C. F. W. Muesebeck of the United States National Museum and Captain Robert Traub, Sn. C., made many helpful suggestions in the preparation of this paper. The flea is named for Dr. J. V. Irons, Associate Director of Laboratories, Texas State Department of Health.

Family **Dolichopsyllidae**

Trichopsylla (Pleochaetis) ironsi n. sp.

Holotype Male.—*Head* (fig. 1): Frontal tubercle small; three rows of preantennal bristles, the first of eleven bristles of varying size, becoming an irregular row near the antenna (this number varies from nine to twelve in the paratype males), the second row of four large bristles with five very small bristles interspersed, the third row of four large bristles and one very small one (in the paratype males there are sometimes only three large bristles); eight very small delicate bristles on preantennal region of the head bordering the antennal groove (this number varies

considerably in the paratypes); eye small and not heavily pigmented; genal process sharply acuminate; labial palpi slightly shorter than fore coxa; postantennal region with three rows of bristles; the first consisting of four large bristles (only three in some paratypes), the second of five (four to seven in paratypes) and the third of six large bristles and three very small ones; a row of eight (varies considerably in paratypes) delicate bristles on postantennal region of the head paralleling the antennal groove; bristles on second segment of antenna reduced.

Thoracic and Abdominal Segments (figs. 2, 3, and 4).—Pronotal ctenidium of twenty slender spines; a single large antepygidial bristle present; tergite VIII enlarged; sternite X reduced to small flaps; sternite IX broad and not divided into lobes, a single large bristle anteriorly; sternite VIII consists chiefly of two large, membranous flaps; movable finger approximately three times as high as wide and bearing five spiniforms of varying thickness and length; clasper with two long acetabular bristles, a more delicate bristle present apically; penis long and slender; spring not quite completing one full turn.

Legs.—Tarsi V with five lateral plantar bristles, the first pair displaced medially; hind tarsi I not exceeding II and III together; outer surface of fore femur with several small setae.

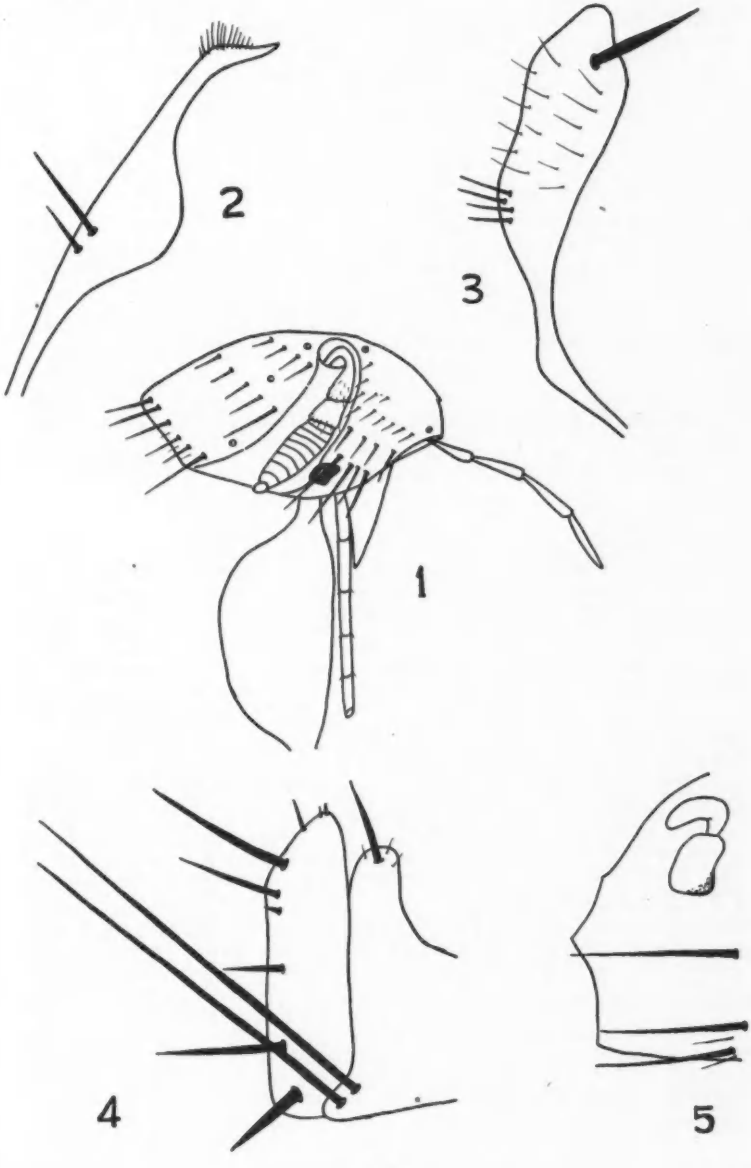
Allotype Female.—Head: Three rows of preantennal bristles present as in the holotype, first row six in number (varies in paratype females from six to eight), second row of four large bristles, third row of four large bristles (paratype females with three to five large bristles); on preantennal region of head bordering the antennal groove a row of six very delicate bristles; on postantennal region of head bordering antennal groove a row of eleven very delicate bristles, in addition to the three rows of stout bristles, the first of three (paratypes with three or four), the second of six (paratypes with four to seven), and the third of seven large bristles and four small ones.

Abdominal Segments (fig. 5): Three stout antepygidial bristles present, the inner member three times as long as the outer two; the spermatheca longer than wide, with arm of approximately the same length, arm about half as thick as the body; style long and slender, over twice as long as width at base, one lateral bristle present; sternite VII without a pronounced sinus.

Holotype.—A male collected by the writer from *Baiomys taylori*, taken near Yoakum, Texas, March 21, 1946. Deposited in the collection of the Texas State Department of Health, Austin, Texas. *Allotype.*—A female collected with the holotype and also deposited in the collection of the Texas State Health Department, Austin, Texas. *Paratypes.*—Twenty specimens taken from six *Baiomys taylori* from Yoakum, Texas, March 19, 1946; eleven specimens from one *Baiomys*

EXPLANATION OF PLATE I

FIG. 1. *Trichopsylla* (*Pleochaetis*) *ironsi* Eads, head, holotype male. FIG. 2. *Trichopsylla* (*Pleochaetis*) *ironsi* Eads, sternite VIII, holotype male. FIG. 3. *Trichopsylla* (*Pleochaetis*) *ironsi* Eads, sternite IX, holotype male. FIG. 4. *Trichopsylla* (*Pleochaetis*) *ironsi* Eads, finger, clasper, holotype male. FIG. 5. *Trichopsylla* (*Pleochaetis*) *ironsi* Eads, spermatheca and sternite VII, allotype female.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taylori from Yoakum, Texas, March 21, 1946; thirteen specimens taken from three *Baiomys taylori* from Yoakum, Texas, April 17, 1946; fourteen specimens taken from three *Baiomys taylori* from Yoakum, Texas, April 18, 1946; three males and three females were sent to the U. S. National Museum; five specimens from four *Baiomys taylori* from Hallettsville, Texas, April 18, 1946. All paratypes were collected by the writer.

Type host.—*Baiomys taylori.*

Type locality.—Yoakum, Texas.

This new species is related to *Pleochaetoides bullisi* Augustson both as to type of host and general chaetotaxy. However, the modified segments of the male are sufficiently different to render separation easy. *P. bullisi* females are not known.

The host determination is by Dr. W. B. Davis, Head of the Fish and Game Department, Texas A. & M. College, College Station, Texas.

REFERENCES

1. **Auguston, G. F.** 1944. "A New Mouse Flea, *Pleochaetoides Bullisi*, N. Gen., N. Sp., From Texas." The Journal of Parasitology, Vol. 30, No. 6.
2. **Ewing, H. E.,** and **Fox, I.** 1943. "The Fleas of North America." U. S. Department of Agriculture, Misc. Pub. 500; 1–143.

THE MOSQUITOES OF THE SOUTHERN UNITED STATES EAST OF OKLAHOMA AND TEXAS, by STANLEY J. CARPENTER, WOODROW W. MIDDLEKAUF, AND ROY W. CHAMBERLAIN. Published by the American Midland Naturalist, The University Press, Notre Dame, Indiana. Monograph Series No. 5; 292 pages, 155 figures. Price $4.00.

Regardless of what page you happen to see first in this book, the chances are excellent that you will have a very favorable reaction. It is uniformly of high quality and this is due to careful preparation of subject matter by the authors, fine illustrations by a competent artist, and good editing, printing, and binding.

This study is one of the most thorough faunistic accounts of mosquitoes in any geographic subdivision of considerable size in the United States. A total of 71 species and subspecies is recorded and one is inclined to predict that for indigenous species the record is now complete; that additional species will be introduced has already been proven in current literature.

Each species is uniformly treated under headings of adult female, adult male, fourth instar larva, distribution based on the authors' records and from other areas based on literature, bionomics, and medical or public health significance if any. There are keys to adult females, male terminalia, and fourth instar larvae. The illustrations by Mrs. Elizabeth Kaston are worthy of special report because of their accuracy and beautiful appearance. Illustrations of larvae and male terminalia are regularly given and valuable diagnostic features of certain species such as the egg, wing, leg, mesonotum, and abdomen are included.

In addition to this material, which covers 231 pages, are carefully prepared chapters on technique and identification, a bibliography of 188 references, and an index.

Although this book will be much used as a manual for information, particularly identification, its most valuable function will be as a stimulus to further research. The authors have written so as not to hide gaps in our knowledge; any competent reader can easily discover many problems that can be solved.

—C. E. VENARD.

BIOLOGIES OF TWO MALARIA MOSQUITOES IN NEW GUINEA[1]

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Among the more important mosquitoes affecting the health of native and newcomer alike in New Guinea and adjacent islands are *Anopheles punctulatus* Dön. and *A. farauti* Lav.[2] They are the principal vectors of malaria over most of this wide range. In addition they are possible vectors of human filariasis in parts of these areas. Their extensive distribution and ready adaptation to conditions incident to waging the recent war increased their importance to armies in the field and in camp. Observations reported herein were made during 1943 and 1944 in eastern and northern Papua and on Biak, one of the principal islands of the Schouten Group in the Netherlands East Indies.[3]

RANGE

Both *Anopheles punctulatus* and *A. farauti* have been collected widely over New Guinea, New Britain, New Ireland, the Solomon Islands and the New Hebrides according to Taylor 1930, 1934, 1942, Hérivaux et al. 1939, Lever 1942, Huisman 1929, Walch 1932, Holland 1933, Belkin et al. 1945 and numerous observers in malaria survey units both U. S. and Australian. Most of these observers in published general observations on environmental relationships agree that preferred larval sites are exposed to sunlight.

Unpublished reports from observers in the Australian army show certain geographic limitations to distribution of these species in New Guinea. Lieutenant R. F. Landon collected up the Lakekamo River valley, over the Owen Stanley Range and down the Markham River Valley to the north coast of New Guinea. He found *A. punctulatus* to be scarce and *A. farauti* to be abundant in the coastal strip of kunai (tall grass) flats and savannah forest near the mouth of the river. Ten to 20 miles inland he found the two species to be nearly equally abundant. At Bulldog, some 30 miles inland, the former species was dominant. Higher in the mountains neither was found. On the north side at Wau, elevation 3500–3800 feet, *Anopheles punctulatus* was present.

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[1]Research Paper No. 817, Journal Series, University of Arkansas. Approved for publication by the Director of the Arkansas Agricultural Experiment Station.

[2]Formerly known as *A. punctulatus moluccensis* (Sw. and Sw. de G.). The synonymy of this species has been discussed by Knight and Farner (1944).

[3]Authors and assistants were members of the 17th Malaria Survey Detachment, Army of the United States, at the time these observations were made. Illustrations from photographs made by 4th Medical Detachment Museum and Medical Art Service, Army of the United States.

Captain H. A. Malcolm reported *A. punctulatus* dominant at an altitude of 1500 feet some 20 miles northeast of Port Moresby.

HABITAT

In a general way soil type is important as a factor affecting abundance of these mosquitoes. *Anopheles punctulatus* is dominant where the soil is heavy clay, and *A. farauti* replaces it where the soil is sand or muck. Where the soils intergrade the species are both present. The sandy coastal strip north of Oro Bay has only *A. farauti* as is shown in Table I, but around Milne Bay the shores are clay divides and sandy

FIG. 1. Man-made larval site for *Anopheles punctulatus*. Oro Bay, New Guinea.

deltas, and both species are present. In the foothills west of Oro Bay the sand is replaced by clay and *A. punctulatus* is dominant. Pools in the red clay soil of Biak are sources of *A. punctulatus* to the exclusion of the other. A few muck beds and tidal pools provide a limited source of *A. farauti* on this island.

Larvae of both species develop in ground pools largely. *A. punctulatus* larvae were most abundant in sunlit depressions such as tracks of animals, man and vehicles (Table I). Under plantation conditions tracks of pigs, cattle, man and carts provided numerous larval sites. When any camps were constructed many more favorable sites were created by trucks, (fig. 1) construction machinery and excavations.

Additional natural larval sites included pools with flotage (fig. 2), pools with filamentous algae, bomb craters, hog wallows, intermittent streams, grassy pools and ditches. Rarely have larvae been taken from mangrove swamps, sago swamps, tin cans and brackish water. No larvae were collected from tree holes, coconuts, foul water or discarded paper cartons or wooden amunition boxes although representative samples of water were examined.

Larvae of *A. farauti* were found most often in sunlit depressions such as shallow pools especially in those with floating sticks (fig. 3) or vegetation (Table I). Tracks of all sorts were important sources also. Grassy margins of sluggish streams were common larval sites, but no larvae have been observed in grassy margins of fast flowing streams. Larvae have been collected in partially shaded portions of mangrove

TABLE I

RELATIVE IMPORTANCE OF LARVAL HABITATS OF *Anopheles punctulatus* AND *Anopheles farauti*, NEW GUINEA, 1943 AND 1944

HABITAT	LARVAE IN 100 DIPS			
	Milne Bay (North Shore)		Oro Bay (Coastal Strip)	
	A. punctulatus	*A. farauti*	*A. punctulatus*	*A. farauti*
	Number	*Number*	*Number*	*Number*
Wheel ruts	26	8	0	35
Pools (surface free)	18	7	0	37
Pools (floatage)	13	11	0	54
Pools grassy	3	4	0	24
Stream margins	2	10	0	5
Mangrove	6	0	0	9
Sago	1	1	0	2
Metal containers	0	0	0	1

swamps subject to only slight tidal fluctuation, and were especially likely to be present if flotage was abundant. Sago swamps, metal containers and lakes were of little importance as sources of this species, and no larvae were collected in tree holes, coconuts, foul water or empty cartons although representative samples of water were examined.

Observations outlined above on relative importance of certain environments as sources of both species are based on data obtained by dipping in Milne Bay and Oro Bay areas. Using white enamel dippers as sampling devices, 46,074 records were obtained from all sorts of representative habitats. In Table I are shown summaries of collections from the more abundant potential larval sites.

LIFE HISTORY

General.—Life histories of *A. punctulatus* and *A. farauti* are similar in general to those of other species in the genus. The tiny black eggs

supported by two lateral floats rest horizontally in a meniscus along some floating or emergent object during incubation. After a variable incubation period, a larva hatches by pushing off the anterior end of the egg and wriggling free. Larvae first skim about vigorously over the surface before they come to rest in a horizontal position in a meniscus adjacent to some object. In water lacking flotage or emergent objects, larvae feed in open water where they are more restless than otherwise. In order to feed, a larva rotates its head so that the mouth bristles may vibrate in the surface film where a current toward the mouth is created. Food consisting of minute floating particles and possibly micro-organisms drifts with the current toward the mouth. Rate of development

FIG. 2. Natural larval site for *Anopheles punctulatus*. Oro Bay, New Guinea.

is rapid when food is abundant so that a larva may pass the four instars within a week or so. The pupal stage is completed in a day of two. Adults leave the larval site at night and possibly on dark days during which time they mate and seek blood. Oviposition occurs a week or so after emergence. Under favorable conditions females may live several weeks in summer. More specific details regarding development of the two species follow.

Egg Stage.—Eggs of both species are jet black, very slightly crescentic with two prominent lateral floats. In a natural environment they are difficult to find because they rest high in a meniscus against

a floating object or margin of a pool. Many cling to surfaces where they were left by receding water. Incubation required from two to six days for both species (Tables II and III) in the laboratory where the eggs were kept floating. The mean incubation for *A. punctulatus* was 2.5 days as against 3.5 days for *A. farauti* under these conditions. Eggs resting on moist surfaces incubated at the normal rate but did not hatch until floated. In the laboratory eggs resting on a moist surface remained viable as long as 14 days after being deposited. Viable eggs so treated normally hatched within a few minutes after flotation. Unti, 1943, reported from South America that eggs of *Anopheles albitarsis* Arrib., *A. argyritarsis* R-D, *A. pessoai* Galvão and Lane, *A. noroestensis*

FIG. 3. Natural larval site for *Anopheles farauti*. Oro Bay, New Guinea.

Galvão and Lane, and *A. strodei* Root would remain viable on moist paper 15 days during winter.

Larval Stage.—Larvae of these two species represent extremes in relative activity. *A. punctulatus* larvae were observed to be restless, seldom remaining in one place more than a few minutes, except as prepupae and before each molt. Examination of living larvae under a microscope usually required several minutes each because they moved so often. Larvae of *A. farauti* on the other hand move little except when disturbed. Normally they rest close against some object or bank where they may remain for hours. Examination of living larvae of this latter species is facilitated considerably by this habit.

Differences in activity of the two species is also related to differences in rates of growth as is shown in Tables II and III. Larvae of both species were reared in the laboratory in petri dishes under comparable conditions. Yeast moistened to form a paste was fed to the larvae on pieces of rock barely submerged. Larvae of the same age and species were kept as the same lot in one dish. Each day all lots were examined and larvae that had molted were removed to other dishes. Under these conditions *A. punctulatus* completed four instars in six to 11 days or in a mean of 7.5 days while *A. farauti* required seven to 18 days or a mean of 11.3 days. Each instar of the latter species required about a day longer on the average than was true for *A. punctulatus* as is shown in Tables II and III.

Pupal Stage.—The pupal stage requires about one day for completion for both species, but *A. farauti* takes a little longer as is shown in Tables II and III.

TABLE II

DURATION OF IMMATURE STAGES OF *Anopheles punctulatus* IN LABORATORY, ORO BAY, 1944

STAGE	NUMBER	DURATION		
		Maximum	Minimum	Mean
		Days	*Days*	*Days*
Egg	429	6	2	2.56 ± 0.05*
First larval instar	385	4	1	2.02 ± 0.05
Second larval instar	339	3	1	1.47 ± 0.02
Third larval instar	315	3	1	1.50 ± 0.03
Fourth larval instar	238	3	1	2.45 ± 0.03
Pupa	238	2	1	1.00 ± 0.01
Larva and pupa	225	12	7	8.44 ± 0.05

*Standard error.

TABLE III

DURATION OF IMMATURE STAGES OF *Anopheles farauti* IN LABORATORY, ORO BAY, 1944

STAGE	NUMBER	DURATION		
		Maximum	Minimum	Mean
		Days	*Days*	*Days*
Egg	398	6	2	3.53 ± 0.05*
First larval instar	174	7	1	3.21 ± 0.05
Second larval instar	174	5	1	2.51 ± 0.07
Third larval instar	174	6	1	2.26 ± 0.03
Fourth larval instar	174	8	2	3.33 ± 0.09
Pupa	174	3	1	1.21 ± 0.01
Pupa and larva	173	19	9	12.57 ± 0.24

*Standard error.

Larval development of both species varies according to relative exposure of developmental site to the sun under natural conditions. In exposed sites where water temperature was often 95 degrees F. and more, larvae of *A. punctulatus* have been observed pupating on the fifth day after hatching. Shaded pools and all pools in prolonged cloudy weather are much cooler than those exposed to direct sun, and larvae in them may not mature in less than two weeks after hatching.

Relation to Control.—Differences in duration of aquatic stages of the two species are significant in planning control operations for an area like an army base. Since *A. punctulatus* may develop from hatching to emer-

FIG. 4. Natural resting site for adult *Anopheles punctulatus*. Bank of Embogo River, Oro Bay, New Guinea.

gence in six days under favorable conditions in the field, oiling operations must be repeated at least every five days to insure adequate coverage. In practice oiling was carried out twice each week. In locations where *A. farauti* is the only species present as was the case north of Oro Bay, oiling operations carried out once each week assured adequate timing.

Adult Stage.—Adults of *A. punctulatus* were collected consistently and in numbers in their resting places, but dependable collecting places for *A. farauti* were not found. The former may be collected along moist banks near sources of blood. Such a site shown in fig. 4 is a bank

of the Embogo River at Hanagela village in the foothills near Oro Bay. At the time observations were made this bank was about six feet high, was nearly vertical, was pitted with shallow cavities and the face was not exposed to direct sun. Very little grass or debris was present. Although the bank was much the same for about 50 yards, nearly all adults were present along that part shown in fig. 4. Directly above this site natives sat on the ground and daily worked at certain chores during the interval in which observations were being made. Thus it seems that banks near soil bearing fresh body odor is attractive for resting sites. This is indicated at another resting site on a narrow stretch of a low bank (two feet high) obscured by overhanging grass in heavy shade near Kieta Creek labor camp one mile north of the location described above. A frequently used native trail passed along the bank directly above the collecting site. No mosquitoes were to be collected beyond the point where the trail veered away from the bank. A third collecting site at Milne Bay was a bank with overhanging grass within a few feet of a frequently used native trail and near a small village. Both males and females were collected at these sites, and the females had probably fed the night before collection as all contained fresh blood. Dissections and also observations on oviposition showed these to be newly emerged females. *A. farauti* adults were collected at the Kieta Creek site described above, but observations were too limited to show this is a typical site. Unfortunately no comparable sites were known in areas where larvae of this species were abundant.

The limit of effective range of flight for adults of *A. punctulatus* was observed for one area near Oro Bay. This experiment was carried out in the narrow valley of the Embogo River above and below Hanagela village. The lower end of the area includes a part of a coconut and rubber plantation, and the upper part is compressed to a narrow ravine between steep hills. This area lay outside the boundary of a large army base and had remained much the same as it was pre-war, and no mosquito control had been practiced at any time.

This experiment was based on the reduction of adult abundance by progressive elimination of larvae about a central point. Preliminary observations included (1) determination of adult abundance and (2) location of all larval sources. In order to determine natural abundance of adults, all mosquitoes on a 50-foot section of the river bank at Hanagela were collected daily for eight days before treatment began. These were always newly emerged mosquitoes and represented new arrivals from larval sites. Daily collections of adults continued of course until the end of the experiment. Larval sites were located and indicated on a large scale map. Larval elimination was accomplished by applications of No. 2 diesel oil sprayed from knapsack sprayers by native labor under direct supervision of trained enlisted technicians. Each pool sprayed was checked on a map as it was sprayed. Other crews of observers with dippers followed spraying crews and searched for inadequately oiled sites. All sites not properly covered were sprayed immediately. All area within a radius of one-quarter mile was thus oiled twice and checked twice at the beginning of the experiment. Effect of this treatment was determined by the daily collections made during the eight-day interval beginning one week after the first spraying

was completed. At the end of this interval all larval sites within a radius of three-quarters mile were treated and checked in the manner described for those within one-quarter mile radius. One week after this area had been covered, daily counts for another eight days were made to determine the adult abundance.

The effect of progressive elimination of larvae about a central point on adult abundance is shown in Table IV. Before treatment average daily collections of females and males was 29 and 36 respectively at a centrally located collecting site. After oiling all larval sites within one-quarter mile radius, average daily collections of females and males was 24 and 19 respectively. Obviously little change in adult incidence was brought about by destruction of larvae in such a small area. Extension of the treated area to three-quarters mile radius reduced females and males to an average daily catch of one and three respectively. The female population was reduced nearly 97 per cent, a figure well within limits of practical control.

TABLE IV

EFFECT OF PROGRESSIVE ELIMINATION OF LARVAL DEVELOPMENT ON ABUNDANCE OF ADULT *Anopheles punctulatus*, HANAGELA, ORO BAY, MAY AND JUNE, 1944

INTERVAL	DAILY COLLECTIONS					
	FEMALES			MALES		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
	No.	*No.*	*No.*	*No.*	*No.*	*No.*
Before treatment.....	36	16	29	63	15	36
8–15 days after treating one-fourth mile	37	11	24	29	10	19
8–15 days after treating three-fourths mile.....	4	0	1	8	0	3

Adult collections were continued six weeks after the last application of oil in order to determine the time required for adult incidence to return to normal. During the first two weeks adult collections were consistently low, but by the sixth week average daily collections were approximately the same as they were before the experiment began.

Data on the longevity of adults are inconclusive because those reared in the laboratory could not be induced to oviposit dependably. Some lived 35 days and fed often while others died in a few days without feeding. Newly emerged and engorged females collected in the field died following oviposition because subsequent blood meals were denied them.

Both species have similar oviposition habits according to observations on wild engorged females in cages. Eggs were laid on moist surfaces as readily as on water. Caged mosquitoes provided with bowls

lined with moist filter paper and others partly filled with water laid eggs in about equal numbers in each. For instance, females of *A. punctulatus* in one cage laid 847 eggs on moist paper and 799 eggs in a bowl containing water. Many of the eggs in the bowl containing water were deposited well above the water on the paper-lined sides. Superficial field observations indicate that such is the case under natural conditions. For example at Milne Bay in 1943 and on Biak in 1944, larvae of *A. punctulatus* in the fourth instar were found in wheel ruts on the fourth day after daily observation from the time of flooding. As has been shown in another part of this paper, eggs require an average of 2.5 days for incubation, therefore they must have been present prior to flooding.

DISEASE RELATIONS

Both *A. punctulatus* and *A. farauti* are recognized as important vectors of malaria in New Guinea. Opportunity to observe the extent

TABLE V

INCIDENCE OF PLASMODIUM OOCYSTS IN NATURALLY INFECTED *Anopheles punctulatus* AND *Anopheles farauti*, HANAGELA VILLAGE, ORO BAY, NEW GUINEA, 1944

DATE OF COLLECTION	STOMACHS EXAMINED		STOMACHS INFECTED		INFECTION RATES	
	punctulatus	*farauti*	*punctulatus*	*farauti*	*punctulatus*	*farauti*
	No.	*No.*	*No.*	*No.*	*Percent*	*Percent*
25 April–23 May	217*	0	11	.....	5.1	.....
24 May–28 May	80	27	6	2	7.5	7.3
29 May–4 June	0	29	.....	0	.....	0.0
6 June–21 July	117†	76	3	3	2.5	3.9
Total	414	132	20	5	4.8	3.8

*Glands were infected in two specimens.
†Glands were infected in one specimen.

of infection in these two mosquitoes was provided when numbers of them were collected at Hanagela and Kieta Creek, two villages where malaria was prevalent. Females were collected on banks in the interval between 25 April and 21 July, 1944. Previous observations showed that adults taken at these sites were newly emerged and possibly had taken no more than one blood meal. They were kept alive six days in the laboratory by feeding them juice of boiled raisins. Dissections were made in the usual manner extracting first the gut, then the glands. Examinations of 414 *A. punctulatus* showed 20 with oocysts on the stomachs which was an average of 4.8 per cent infected as shown in Table V. Incidentally three of these showed sporozoites in the salivary glands. Examinations of 132 *A. farauti* showed five with oocysts which was an average of 3.8 per cent infected, but none showed sporozoites.

The low sporozoite count may be attributed to the fact these mosquitoes possibly had had no more than one blood meal, and usually that had been taken the night before capture. Further evidence that specimens were recently emerged at the time of collection is shown by dissections of 294 *A. punctulatus* made during first three days after capture where only four bore oocysts large enough to distinguish. The average number of oocysts on the guts of infected *A. punctulatus* and *A. farauti* were six and four respectively. One *A. punctulatus* bore as many as 30 oocysts on the stomach wall.

In addition to malaria parasites, unidentified filarid larvae were found in both species. In the thoracic cavities of 414 *A. punctulatus*, they were found in 16 or 3.8 per cent. In 132 *A. farauti*, they were found in three or 2.3 per cent. These filarid larvae are presumed to be those of *Wuchereria sp.*

SUMMARY

1. Malaria, one of the worst hazards to be encountered by native and newcomer alike in New Guinea, is transmitted by *A. punctulatus* Dön., *A. farauti* Lav. or both. The former species was found most abundant wherever clay soil is found whether at sea level or inland. It has been reported to occur as high as 3500 feet in the mountains. The latter was present on the coastal plains where sand and muck are present.

2. Larvae of both species are present in collections of water in all sorts of tracks and are especially abundant in clearings incident to construction of army camps. Natural pools and grassy margins of sluggish streams are choice sites for larvae of *A. farauti*.

3. Differences exist in rates of development of the two species. Consistently *A. punctulatus* develops more rapidly requiring on the average one day less for the egg stage and each larval instar. In the laboratory the average time required for the aquatic interval was 8.5 days for *A. punctulatus* and 12.5 days for *A. farauti*. In the field under very favorable conditions the former may complete larval and pupal periods in five or six days.

4. Eggs of both species may be deposited on moist surfaces or water, and in the former case they may remain viable for at least 14 days.

5. Adults of these species were collected on moist banks near village sites. *A. punctulatus* has been most commonly collected on vertical banks out of direct sunlight within a few feet of a frequently used trail or place where natives sit on the ground to work.

6. The limit of effective flight range of *A. punctulatus* was three-quarters mile as determined by larval elimination in a native area near Oro Bay. After oiling an area within a radius of three-quarters mile, females at a central collecting site were reduced to about three per cent of the number before treatment.

7. A population of *A. punctulatus* at an adult collecting site returned to normal within six weeks after larvae were eliminated in an area within a radius of three-quarters mile.

8. Both species are recognized as important vectors of malaria. Examination of stomachs of 414 *A. punctulatus* females fed once in the

wild showed 20 or an average of 4.8 per cent with oocysts. Three had sporozoites in the salivary glands. Examination of stomachs of 132 *A. farauti* showed five or 3.8 per cent with oocysts.

9. Unidentified filarid larvae presumed to be *Wuchereria sp.* were found in both species. Infection of *A. punctulatus* was 3.8 per cent and 2.3 per cent for *A. farauti.*

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CATALOGO DE LOS INSECTOS QUE ATACAN A LAS PLANTAS ECONOMICAS DE CUBA, by S. C. Bruner, L. C. Scaramuzza and A. R. Otero. 246 pages, 12 plates. Bulletin No. 63 of the Estacion Experimental Agronomica, Santiago de las Vegas. Published by the Ministerio de Agricultura, September, 1945.

The arrangement of this catalog is admirable. In the body of the book plant genera are entered in bold-face capitals, alphabetically arranged. Under each genus the species considered are made conspicuous by bold-face type, and under the species the insects attacking them are also in bold-face, arranged by orders with a center head in capitals where several species of the same order are included. The result is an exceedingly usable manual. Further, the index is conveniently divided into sections on insects and other arthropods, both arranged by orders, and on natural enemies and vernacular names of plants. The twelve excellent half-tone plates include seventy-six figures, mostly of adult insects of various orders. The wealth of information included, the excellent arrangement and the fine quality of the printing are a tribute to everyone concerned in the production of the bulletin.—A. W. L.

DESCRIPTION OF THE LARVA OF KEIFERIA PENICULO HEINRICH, WITH A KEY TO THE LARVAE OF RELATED SPECIES ATTACKING EGGPLANT, PEPPER, POTATO AND TOMATO IN THE UNITED STATES

(Lepidoptera: Gelechiidae)

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In the course of the special survey which the Bureau of Entomology and Plant Quarantine conducted in 1944–45 in the vicinity of ports of entry, larvae of a new gelechiid were frequently found feeding on eggplant. Adults were reared by members of the survey staff, and the species has been recently described as *Keiferia peniculo* by Heinrich.[1]

All the species treated here have the normal family characters, viz.: Anterior seta A^3 of the head remote from lateral seta L^1, as near or nearer to A^2 than to L^1. Prespiracular group of prothorax trisetose. Group VII of first abdominal segment bisetose. Abdominal prolegbearing segments with seta IV approximate to V below the spiracale; group VII trisetose. Paired setae II of the ninth segment not on a single pinaculum. Seta I of ninth segment little, if any, closer to seta III than to seta II; each on a separate pinaculum. The following description of the larva of *peniculo* and key are submitted to assist field workers in recognizing it and the various associated species of *Keiferia* and *Gnorimoschema*.

Keiferia peniculo Heinrich

Mature larva 7–7.5 mm. in length.

Head flattened, slightly broader than high, pale yellow with a broad, dark, fuscous lateral band extending from incision of posterior margin into ocellar area and with intensity of the pigmentation often reduced beyond seta O^2. Dark pigmented spots present under ocelli. Frons approximately one-half height of epicranium; seta Adf^1 from middle or slightly above middle, with Adf^2 approximate and closer to Adf^1 than to apex of frons. Posterior seta P^1 laterad of Adf^1 and but slightly more distant than Adf^2 is from Adf^1; P^2 remote from and only slightly above level of P^1. Anterior seta of ultra-posterior group (X) approximate to and directly above P^2. Anterior setae A^1, A^2, and A^3 forming an obtuse angle, with setae A^1 and A^3 about equally distant from A^2. Seta L^1 remote from A^3 and approximately on level of P^1. Ocellar setae O^1 and O^2 approximate to ocelli I and III, respectively; line joining bases of setae L^1 and O^2 distinctly posterior to margin of ocellus I; seta O^3 remote from and slightly below level of ocellus VI.

[1]Heinrich, Proc. Ent. Soc. Wash. 48 (2): 35–36, 1946.

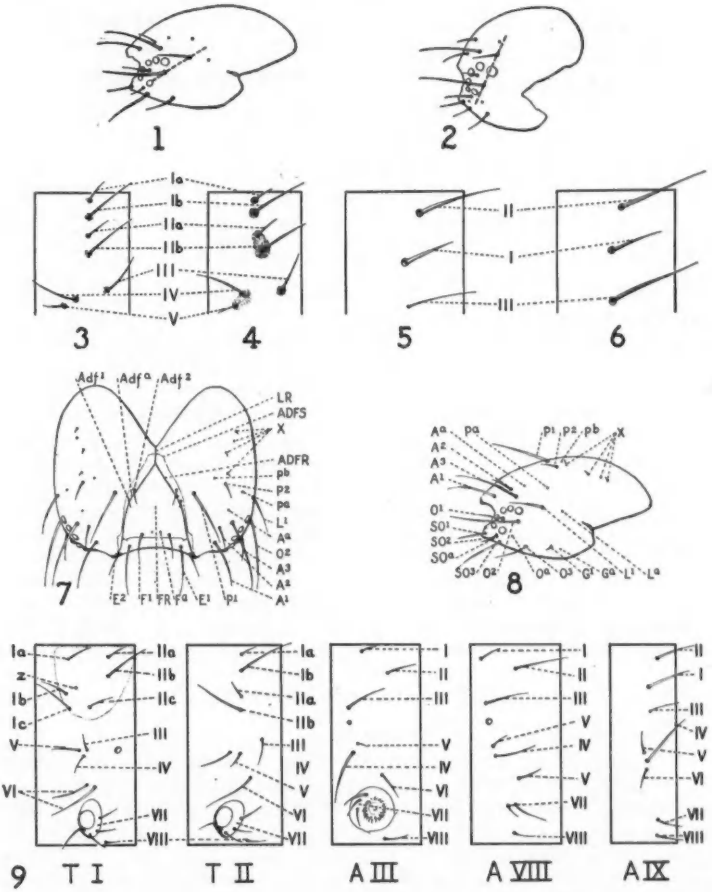

FIG. 1. Lateral aspect of head capsule of *Keiferia peniculo* indicating relative position of setae L^1 and O^2 to ocellus I. FIG. 2. Same of *Gnorimoschema gudmannella*. FIG. 3. Portion of mesothoracic segment with setae IIa and IIb on separate plates (semi-diagrammatic). FIG. 4. Same with IIa and IIb on a single fused plate. FIG. 5. Portion of ninth abdominal segment with seta III modified (semi-diagrammatic). FIG. 6. Same with seta III normal. FIG. 7. Dorsal view of head capsule of *Keiferia peniculo*. FIG. 8. Lateral view of head capsule of *Keiferia peniculo*. FIG. 9. Setal map of body segments of *Keiferia peniculo*.

Drawings prepared by Arthur D. Cushman, of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Prothoracic shield uniformly pale yellowish amber, or with a posterior fuscous pigmentation which is broader and more intense middorsally. Thoracic legs sordid white, concolorous with the body. Crochets on abdominal prolegs 20–25, biordinal, arranged in a circle which is weaker outwardly and occasionally slightly broken. Ninth abdominal segment with seta III modified (slenderer than I or II); setae IV, V, and VI approximately in line.

Superficially resembling *K. lycopersicella* and *K. glochinella*, but the former has the thoracic legs darkly pigmented, and the latter has seta III of the ninth abdominal segment normal (as strong as I or II).

KEY FOR SEPARATION OF GNORIMOSCHEMA AND KEIFERIA LARVAE ATTACKING EGGPLANT, PEPPER, POTATO, AND TOMATO IN THE UNITED STATES

1. Seta III on ninth abdominal segment normal, as strong as or stronger than seta I or II (fig. 6) 2
   Seta III on ninth abdominal segment modified,[2] weaker than seta I or II (fig. 5) 3
2. Head flattened, plates at bases of setae IIa and IIb on meso- and metathorax separate (fig. 3). (Eggplant) ..... **Keiferia glochinella** (Zell.)
   Head rounded, not appreciably flattened; plates at bases of setae IIa and IIb on meso- and metathorax fused, forming a single plate (fig. 4). (Potato), **Gnorimoschema plaesiosema** (Turner)
3. Thoracic legs with brown or blackish pigmentation 4
   Thoracic legs pale, whitish, concolorous with body 5
4. Prothoracic shield pale, with a conspicuous dark fuscous shading along lateral and posterior margins. (Eggplant, potato, and tomato), **Keiferia lycopersicella** (Busck)
   Prothoracic shield uniformly brown or black. (Eggplant, potato, and tomato) ..... **Gnorimoschema operculella** (Zell.)
5. Head flattened; line joining bases of setae L^1 and O^2 posterior to ocellus I (fig. 1). (Eggplant) ..... **Keiferia peniculo** Heinrich
   Head rounded, not appreciably flattened; line joining bases of setae L^1 and O^2 tangent to or passing through ocellus I (fig. 2). (Pepper), **Gnorimoschema gudmannella** (Wlsm.)

[2]Magnification required depends on size of the specimen. A satisfactory method is to place the larva in a Syracuse watch glass or a shallow dish containing 95-percent alcohol and examine under a wide field microscope with adequate illumination.

THE NATURALISTS' DIRECTORY, THIRTY-FOURTH EDITION. 204 pages. Published by the Cassino Press, Salem, Massachusetts, 1946. Price $3.00.

This latest edition of the scientists' old friend is in the old format, with stiff paper covers. Names are listed by states, as before, and an increased number of foreign countries are included following the section devoted to the United States. One section lists scientific periodicals and another museums of natural history, the latter listed by states. A short appendix contains unclassified names received too late for inclusion in the main part of the directory. The chief interests of collectors are noted, together with the usual information on their desire to buy, sell or exchange. A number of interesting advertisements of dealers and collectors appear in this edition.—A. W. L.

ADDITIONAL NOTES ON THE TABANIDAE OF PANAMA[1] (Diptera)

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In 1942 I listed (Ann. Ent. Soc. Amer., 35, No. 4, p. 471) the 89 species of Tabanidae then known from the Republic of Panama and the Canal Zone. Since that time a certain amount of additional material has accumulated which makes it seem advisable to publish the present additional note. Nine species are added to the Panama fauna, six of which are described as new, bringing the total species recorded to 98. The heretofore unknown males of several species are described, and additional material and extension of ranges of a number of hitherto poorly known species are recorded.

I am very much indebted for much of what is interesting in this material to Messrs. Philip S. Marucci and George L. Wood, of the Army School of Malariology, to Dr. Thomas G. Aitken and to Mr. C. M. Keenan, Assistant Sanitary Inspector, Panama Canal Department, and I hereby express my grateful acknowledgment of their invaluable cooperation.

Assipala tanycerus (Osten Sacken)

Chrysops tanycerus Osten Sacken, 1886, Biol. Cent. Amer., Dipt. I, pp. 46–47 (♀; Costa Rica). Kértesz, 1900, Cat. Tab., p. 12. Ricardo, 1901, Ann. Mag. Nat. Hist., Ser. 7, 8, pp. 310 and 313. Aldrich, 1905, Cat. Dipt. N. Amer. Ent., p. 198. Surcouf, 1921, Gen. Insec., Taban., p. 155. Hine, 1917, Trans. Amer. Ent. Soc., 43, p. 292 (♀; Peralta Station, Costa Rica). Kröber, 1925, Konowia, 4, pp. 217, 221, 238; 1930, Zool. Anz., 90, pp. 73–74, figs. 11–12 (♀; Higuito, San Mateo, Costa Rica); 1934, Rev. Ent., 4, 2, p. 229. Pechuman, 1937, Rev. Ent., 7, 2–3, p. 140.

Assipala tanycerus Philip, 1941, Canad. Ent., 73, p. 4 (January); 1941, Rev. Ent., 12, 3, pp. 470–473 (December).

A single female, El Volcan, Chiriqui Province, Panama, February 15, 1943, T. Aitken coll. This interesting species is the type of the genus, and has been hitherto known only from Costa Rica. It may be distinguished from all other species occurring in Panama by the greatly elongate antennae with the terminal segment not half as long as either of the two preceding segments. The wing pattern is not very *Chrysops*-like, consisting of an abbreviated cross-band and large separate apical spot, while the cross-veins and fork of the third vein are surrounded by dark clouds.

Chrysops scalaratus Bellardi

1859, Ditt. Mess., Pt. 1, p. 72, Pl. 2, fig. 19 (♀; Mexico). Osten Sacken, 1878, Cat. Dipt. N. Amer., p. 54. Kértesz, 1900, Cat. Taban., p. 11. Ricardo, 1901, Ann. Mag. Nat. Hist., Ser. 7, 8, pp. 299, 304 (♂, ♀; Mexico, Honduras,

[1]The cost of publication of this article is paid by the Gorgas Memorial Laboratory.—EDITOR.

Chile; = ? *lateralis* Wied.). Kröber, 1925, Konowia, 4, pp. 216, 227, 362–363, Pl. 1, fig. 16; Pl. 3 and Pl. 5 (Br. Honduras, Costa Rica, Guatemala); 1934, Rev. Ent., 4, 2, p. 229. Bequaert, 1938, Carnegie Inst. Washington, publ. 499, p. 226; 1940, Rev. Ent. 11, 1–2, p. 270.

Chrysops apicalis Bellardi, 1859, Ditt. Mess., pt. 1, p. 73 (♂, Mexico). Pechuman, 1939, Bull. Brooklyn Ent. Soc., 34, 5, p. 241 (= ♂ of *scalaratus*).

Chrysops lateralis, Hine, 1925, Occ. Pap. Mus. Zool. Univ. Michigan, No. 162, pp. 14–15 (♂, ♀; Honduras, Guatemala=*scalaratus* Bell.). Not *C. lateralis* Wied., 1828.

A series of 12 females from near Almirante, Bocas del Toro Province, Panama, March 12, 1943, Marucci and Wood colls., a further series taken towards the end of August, 1944, by myself at the same locality, and a single female from Robalo on the shores of Chiriqui lagoon, Bocas del Toro Province, January 21, 1946, P. Galindo coll. Hitherto known from Mexico to Costa Rica, the present material extends the range of the species considerably.

Chrysops auroguttata Kröber

Two females from Coclé del Norte, Colon Prov., September 29, 1942; 9 from Robalo, Bocas Prov., January 21, 1946; 2 from Almirante, Bocas del Toro Prov., August 21, 1944, and 3 from Utria and Valle, Choco, Colombia, August 27 and September 1, 1942, Boshell coll.

Bequaert (Psyche, 51, p. 13, 1944) has recently revised the distinctions between *auroguttata* and *pallidefemorata* Kröber, and concludes that the two forms treated by Kröber as varieties of one species, are really distinct species. One of the specimens from each of the two Panama localities listed here approaches *pallidefemorata* in showing a marked encroachment of hyaline into the marginal cell at the apex of the cross-band, and in having the hyaline area in the fifth posterior cell extensive, reaching quite to the discal cell. All have a marked hyaline spot at the base of the first submarginal cell. The three Colombian specimens are darker, the wing markings more typical of *auroguttata*, but the hyaline spot at base of first submarginal cell is almost obsolete.

In 1942 (Proc. Ent. Soc. Washington, 44, 1, pp. 3–4) I concluded, on the basis of very limited material and largely on wing markings, that Panama material came closest to *pallidefemorata*, in this agreeing with Pechuman (1937, Rev. Ent., 7, p. 136). However, the proportions of the frons, and especially the rather long basal antennal segments agree better with both Krober's and Bequaert's definitions of *auroguttata*. I listed the specimens under *incisa* Macq., but Dr. Bequaert believes that species to be unrecognizable from the description.

Chrysops soror Kröber

One female, Jaqué, Darien Prov., February 9, 1943, Marucci and Wood colls.

Chrysops mexicana Kröber

Two females, Almirante, Bocas del Toro Prov., March 12, 1943, 1 female, Robalo, Bocas Prov., January 21, 1946, P. Galindo coll., and 2 females Pito, Intendencia de San Blas, June 20, 1943, Marucci and Wood colls. Those from Almirante agree with my fig. 6 (Fairchild,

1942, Proc. Ent. Soc. Washington, 44, 1, pp. 1–8), those from Pito with fig. 7. Extensive material may show two distinct species, but which, if either, is Kröber's species is uncertain.

Scione maculipennis Schiner

One female, El Volcan, Chiriqui Prov., July 4, 1943, T. Aitken coll. This specimen agrees with others previously reported from the same area (Fairchild, 1942). Two females from Jaqué, Darien Prov., February 9, 1943, Marucci and Wood colls., are unusual in that the locality is at sea level. The specimens are quite different in appearance from those from Chiriqui, being paler, more obscurely marked, and with the wing markings very faint. The frons is like my fig. 6 and the palpi as in fig. 6 b.

Dichelacera analis Hine and **Dichelacera marginata** Macquart

Two females of the former and one of the latter, Robalo Bocas del Toro Prov., January 21, 1946, P. Galindo coll. Both these species are on the wing only until November or early December on the Pacific side of the isthmus, but the lack of a well marked dry season on the Caribbean side evidently results in a much longer flight season.

Dichelacera (Psalidia) fulminea (Hine)

One male and 6 females from near Almirante, Bocas del Toro Prov., Panama, March 12, 1943, Marucci and Wood, and August 18, 1944, Fairchild. The male is quite similar to the female, but paler, and the dark markings of the wing are considerably reduced. The first posterior cell is open, though narrowly so, while the antennae are more slender and with a shorter tooth than in the female. A female from France Field, C. Z., September 30, 1943, Keenan coll., and another from Muzo, Dept. of Boyacá, Colombia, June 14, 1941, Gast Galvis coll., both show the first posterior cell open, quite widely so in the Panama specimen. This constitutes an exception to the statement (Fairchild, 1940, Ann. Ent. Soc. Amer., 33, p. 692) that this species always has the cell closed, and is a further confirmation of the worthlessness of this character for even specific definition.

Dichelacera (Catachlorops) transposita (Walker)

Three additional females (Pito, Int. de San Blas, June 20, 1943, Marucci and Wood colls.) of this interesting species enable certain corrections to be made to my earlier description (Fairchild, 1940). The sides of the mesonotum and apical third of the scutellum are clothed with white hairs, as is the posterior margin of the last visible tergite. The mid-tibiae are hardly white basally, merely somewhat paler than the remainder of the tibia.

Dicladocera badia Kröber

Nine females from Robalo, Bocas del Toro Prov., January 21, 1946, P. Galindo coll. This species has previously been taken only at Bocas del Toro and Porto Bello, and at El Valle, in Coclé Province. Dr.

Galindo, the collector, said he was informed it had been very abundant a few weeks previously, attacking both man and horses.

Cryptotylus luteoflavus (Bellardi)

Male.—Eyes bare, holoptic, not enlarged. The large facets are but very slightly enlarged, so that a superficial examination would suggest that all facets are of one size. The line of demarkation between large and small facets is imperceptible, and the area occupied by the large facets seems not to exceed about one-third of the total eye area. Vertexal tubercle well developed. Frontal triangle yellow pollinose. Antennae more slender than in female, the dorsal angle slightly more acute. Palpi erect, rather small and slender. Proboscis long and slender, the labelli partially sclerotized. Color almost wholly dull yellow, considerably paler than the female.

Neallotype male, Almirante, Bocas del Toro Province, March 12, 1943, Marucci and Wood colls.

The lack of enlarged eye facets and reduced antennal tooth place this species somewhat apart from its congeners, but the color, general facies, and vertexal tubercle indicates that it is closer to *Cryptotylus* than to *Chlorotabanus*. It is perhaps the least specialized member of the group, approaching in some aspects certain species of *Stenotabanus*.

Diachlorus curvipes Fab.

Male.—Eyes greatly enlarged, causing the head to be markedly wider than the thorax, holoptic, the large facets many times larger than the small, sharply demarcated from them, and occupying over two-thirds of the total eye area. The area of large facets is pale tan, with, in the lower third, a thick, dark, inverted U-shaped mark. Vertexal tubercle present, though small. Frontal triangle golden yellow pollinose. Palpi as large as in the female but more slender, yellow. Coloration much as in the female, though paler throughout. Mesonotal dark markings reduced, the median yellow stripe somewhat broader than in female. Abdomen wholly yellow and apparently wholly yellow haired.

Neoallotype male, Almirante, Bocas del Toro, Panama, March 12, 1943, Marucci and Wood colls.

This appears to be the second species of *Diachlorus* of which the male has been described, Lutz (1913) having figured the male head of *D. conspicuus*, a closely related species. Two females of *curvipes* from the same locality were taken by myself August 18, 1944. These records extend the known range of the species nearly to the Costa Rican border.

Diachlorous jobbinsi Fairchild

Five females from near Almirante, Bocas del Toro Prov., Panama, taken in March and August, extend the range of the species considerably and enable a few additions to the description to be made. The eye pattern in fresh material differs slightly but consistently from the pattern in *curvipes*, the green markings being more slender throughout. Due to an oversight, no figure of this species accompanied the original description (Fairchild, 1942, Ann. Ent. Soc. Amer., 35, p. 296), so for the sake of completeness the species is here figured.

Stenotabanus (Stenotabanus) lerida Fairchild

Three females from El Volcan, Chiriqui Prov., March 6, 1943, T. Aitken coll. This is apparently one of the commonest Tabanids in the Volcan area.

Stenotabanus (Stenotabanus) maruccii, sp. nov.

Female.—Length 10 mm., of wing 10 mm. Eyes bare, in life green with a single broad median purple stripe. Frons parallel sided, about 4 times as high as wide, yellowish grey pollinose Frontal callus black, nearly as wide as frons basally, tapering to a point at about the middle of the frons. Vertexal tubercle prominent, pollinose, and with well-marked vestiges of ocelli. Subcallus, face and cheeks yellowish brown pollinose, the latter with scattered dark erect hairs. Antennae reddish, the first two segments not inflated and with black hairs. Third segment with the dorsal angle acute and bearing a tuft of black hairs. Annulate portion black, hardly half the length of the basal portion. Palpi brownish, moderately slender, blunt-tipped, black haired. Proboscis about two-thirds head height, blackish, the labelli large and membranous. Beard sparse, greyish.

Mesonotum blackish, with a pair of narrow submedian yellowish stripes reaching the scutellum. Lateral margins yellowish and brassy haired. Scutellum blackish, with sparse brassy hairs. Pleura yellowish grey, a dark stripe passing forward from the wing bases. Legs wholly black and black haired. Wings with subepaulet bearing macrotrichia, but less dense than on the costa. Costa, subcosta, and first vein above with macrotrichia. Wings hyaline, the fore border yellowish smoky, and a light though distinct cloud on the fork of the third vein. All cells but the anal open; no appendix on upper branch of third vein. Abdomen mainly black, black haired. First segment wholly and succeeding segments on posterior margins pearly grey pollinose, changing to brilliant pale blue with light of proper incidence. Second, third, fourth and last tergites with small median tufts of pale hairs. Sides of all tergites with sparse pale hairs. Venter black, wholly pearly pollinose, sparsely pale haired on first and second sternites, the rest black haired.

Holotype female, Pito, Int. de San Blas, Panama, June 20, 1943, Marucci and Wood colls. To be deposited in the Museum of Comparative Zoology, Cambridge, Mass.

This little species is structurally closest to the group of *St. lerida* Fchld., though in coloration and general appearance it approaches *tantulus* Hine and *constabulorum* Fchld.

Stenotabanus (Stenotabanus) plenus Hine

One female, Pinogana, Darien Prov., R. P., February 20, 1943, Marucci and Wood colls. The specimen is unfortunately headless, but the species is so characteristic that there is little doubt as to the identification.

Stenotabanus (Stenotabanus) xenium sp. nov.

Female.—Length 14 mm., of wing 11 mm. Frons about 6 times as high as wide, narrowest below, orange brown pollinose. Basal callus

chestnut brown, narrower than frons, club-shaped, extended as a raised ridge more than half the distance to the vertex. Vertexal tubercle present, small, pollinose, but with vestiges of 3 ocelli. Eyes bare, uniformly dark blackish green in life. Antennae orange, only the terminal annulus black. Palpi orange, mostly black haired. Proboscis shorter than head-height, the labelli large and fleshy. Subcallus orange pollinose, without hairs, genae and fronto-clypeus paler with scattered pale hairs.

Mesonotum greyish brown, unstriped. Pleura and sternum pale yellowish. Legs orange brown, black haired, the fore tarsi somewhat flattened. Wings with subepaulet thin and scale-like, pointed, and with about 12 black macrotrichia. Costa, subcosta, first and fifth veins with macrotrichia above. Fork of third vein with a moderate appendage. Whole wing dilute brownish, darker along the costal border. Abdomen bright orange brown, darker apically. Hind margins of tergites with orange hairs, which form complete transverse bands, widest in the middle and at the sides, on segments 2 to 4; segments 1 and 5 to 6 have only mid-dorsal and lateral patches. Rest of abdomen black haired above, orange haired below.

Holotype female and 2 female *paratypes* collected at light, Canal Zone Police Substation, Rio Pequeni, head of Madden Lake, Panama Canal Zone, June 23, 1944. One female *paratype*, San José, Villavicencio, Intendencia de Meta, Colombia, August 1, 1939, M. Bates coll. The specimen from Colombia is a little lighter in color and with slightly broader third antennal segment. *Holotype* and 1 *paratype* to be deposited in the Museum of Comparative Zoology, Cambridge, Mass.

This little species is close to *St. pequeniensis* Fchld., also from the Rio Pequeni, but differs slightly in the shape of frons and antennae, in having prominent bands of orange hairs on the abdomen, in the less prominently marked wings, and in larger size.

Stenotabanus (Aegialomyia) paitillensis Fairchild

Two females taken attempting to bite in a patch of thorny scrub on the tide flats near the salt pans at Aguadulce, Panama, March 4, 1944. These are the only specimens that have been taken since the type was collected.

Tabanus praepilatus Fairchild

Five females in poor condition taken in a mosquito stable trap at Old Panama, August 17, 1943, and two others from Juan Diaz, May 10, 1943, collected by Sr. Beleño.

Tabanus punctipleura Hine

1920, Ohio Journ. Sci., 20, No. 8, pp. 314–315 (♀, San Carlos and Carillo, Costa Rica). Krōber, 1930, Zool. Anz., 86, 9–10, pp. 261–262; 1934, Rev. Ent., 4, 3, p. 296.

Tabanus (*Lophotabanus*) *defilippi* Krōber, 1929, Zool. Anz., 83, 1–4, pp. 126–127, fig. 8 (nec *de-filippii* Bell., 1859).

A single female from near Almirante, Panama, August 18, 1944. Krōber's (1929) description states that the frons is six times as high as wide, but his figure shows it but four times as high as wide. The

length of, and angle at which, the antennal tooth arises is also greater in his figure than in my specimen. The accompanying figure will serve for comparison.

Structurally this species is close to *T. importunus* and *T. ferrifer*, but the dark color and prominent prescutellar spot give it a strong superficial resemblance to *T.* (*Bellardia*) *de-filippii*. These two species form in many ways connecting links between the two groups.

Tabanus praeteritus sp. nov.

Female.—Length 12–13 mm., of wing 11–12 mm. Eyes bare, in life dull green, unbanded. Frons about 4½ times as high as basal width, slightly narrowed below, yellowish grey pollinose. Frontal callus yellowish brown, narrower than frons, higher than wide and prolonged in a short line above. Vertexal tubercle wholly absent. Subcallus, frontoclypeus and genae yellowish grey pollinose, with a fairly dense grey beard. Antennae orange yellow, the first segment somewhat inflated, the third with a fairly well-marked dorsal angle and the darker annulate portion somewhat shorter than the basal portion. Palpi pale yellowish, black haired, inflated basally but with a rather slender apex. Proboscis short, less than head height, the labelli membranous and over two-thirds length of proboscis.

Mesonotum dark grey, unstriped, with mixed dark and brassy hairs. Pleura and sternum steel grey, sparsely pale haired. Scutellum concolorous with mesonotum. Legs orange brown, the fore femora, apical halves of fore tibiae and bases of mid- and hind femora darker. Wings with subepaulet, costa, subcosta and first vein setose. All cells but anal open, no appendix on branch of third vein. Wings entirely hyaline except for the yellowish stigma and faintly tinged costal cell. Abdomen mainly dull yellowish brown with, on the first two tergites, a narrow and not well defined inverted black triangle. The fourth and succeeding segments are darker in the middle, though there is no well defined stripe. The abdomen is mainly densely black haired, but with oval patches of yellow hairs dorsolaterally on the second to fifth tergites. On one specimen there is a very faint indication of a middorsal pale line. Sternites pale yellowish, wholly pale haired.

Male.—Eyes bare, holoptic, the facets hardly differentiated, those on the disk being very slightly larger than those on the margins. Vertexal tubercle present, small, densely haired. Coloration as in the female,

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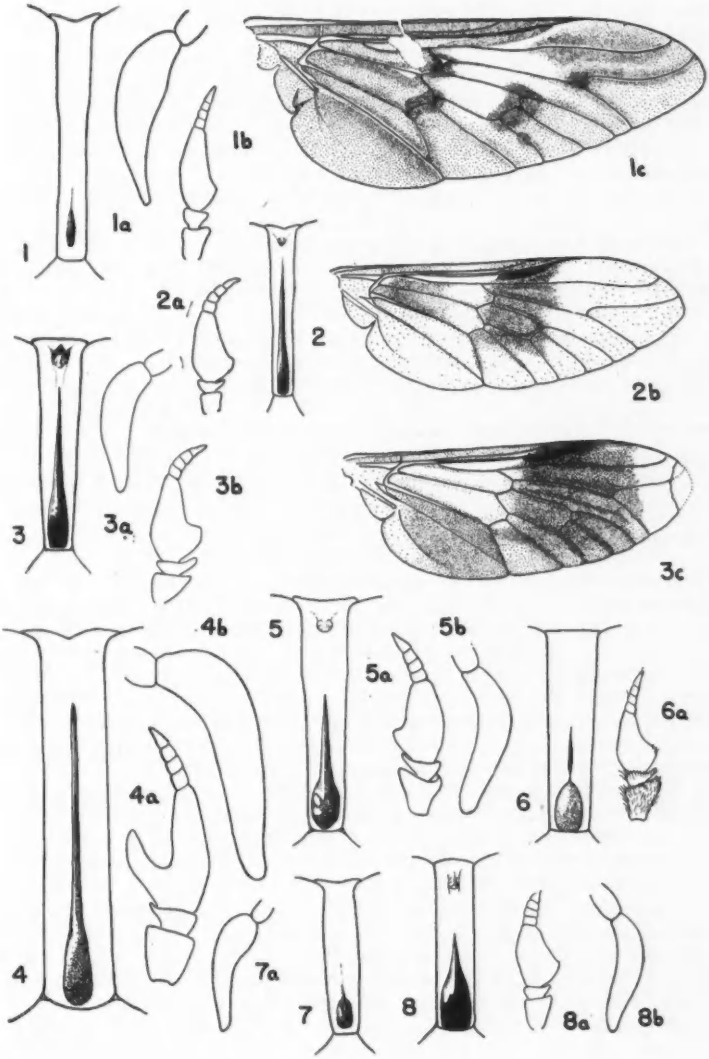
EXPLANATION OF PLATE I

All figures are of the frons, antenna and/or palpus of female specimens, and are all to the same scale as that used in my previous papers on Panama Tabanidae. The figures of wings are drawn from specimens mounted in balsam, and are to a somewhat smaller scale than the other figures.

FIGS. 1, 1a, 1b, 1c, *Tabanus xenorhynchus* sp. now. Holotype (head structures) and Paratype (wing). FIGS. 2, 2a, 2b, *Tabanus* (*Philipotabanus*) *keenani* sp. nov. Holotype. FIGS. 3, 3a, 3b, 3c, *Tabanus* (*Philipotabanus*) *inauratus* sp. nov. Holotype. FIGS. 4, 4a, 4b, *Tabanus punctipleura* Hine. FIGS. 5, 5a, 5b, *Stenotabanus* (*Stenotabanus*) *xenium* sp. nov. Holotype. FIGS. 6, 6a, *Tabanus praeteritus* sp. nov. Holotype. FIGS. 7, 7a, *Diachlorus jobbinsi* Fairch. FIGS. 8, 8a, 8b, *Stenotabanus* (*Stenotabanus*) *maruccii* sp. nov. Holotype.


1
1a
1b
1c
2
2a
2b
3
3a
3b
3c
4
4a
4b
5
5a
5b
6
6a
7
7a
8
8a
8b

but a little lighter in tone. One specimen has a clearly indicated middorsal line, the other not. In the first of these specimens, the upper branch of the third vein, r_4, and veins m_2 and m_3 are incomplete in both wings.

Holotype female, Chepo, Panama Province, Republic of Panama, January 19, 1930, L. H. Dunn coll. *Allotype* male, Ancon, Canal Zone, A. H. Jennings coll. *Paratypes*, 2 females with some data as holotype, 1 female, Porto Bello, Panama, March 2, 1911, A. Busck coll., 1 female, El Real, Darien Prov., Panama, February 7, 1940, D. M. Jobbins coll., 1 female Christobal, Canal Zone, November 2, 1939, Holder coll., 1 male, Ft. Randolph, Canal Zone, January 23, 1929, C. H. Curran coll.

Holotype and 1 female *paratype* to be deposited in the M. C. Z., *Allotype* and 1 female *paratype* in the U. S. National Museum, the male paratype in the American Museum of Natural History, and remaining paratypes in author's collection.

This little species has remained unnamed in my collection for a number of years. I had thought for a time it might be *T. sallei* Bell., and there is little in the description to disagree, but it has so few outstanding characteristics and belongs to a group of very similar appearing species which are only to be distinguished by small structural characters, that I feel obliged to describe it. Its relationships seem to be with the *nigrovittatus* group, its nearest allies in Panama being *T. rixator* Fairch. and *T. nereus* Fairch.

Tabanus xenorhynchus sp. nov.

Female.—Length 16–17 mm., of wing, 15–16 mm. Eyes bare, probably uniformly dark blackish green in life. Frons about 8 times as high as basal width, slightly narrowed below the middle, light grey pollinose. Basal callus weakly developed, brown or blackish, about one-third width of frons and about 3 to 4 times as high as wide, slightly prolonged above. Vertex with a small discolored spot, but without a distinct tubercle. Antennae dark brown to blackish, the basal portion of third segment slender, somewhat less than twice the length of the annulate portion and with a moderate dorsal angle near the base. Palpi blackish or dark brown, black haired, the terminal segment basally inflated, with slender acute apex and longer than antennae. Proboscis long, about equalling head height, the labelli about half its length, wholly membranous. Subcallus, fronto-clypeus and genae brownish grey pollinose, beard brownish, sparse.

Mesonotum chocolate brown, with a pair of dorsolateral white lines reaching the scutellum. Sides of mesonotum and posterior border of scutellum with long and dense silvery white hairs. Pleura and sternum blackish, wholly black haired. Legs wholly black and black haired. Wings with subepaulet, costa, subcosta, first and fifth veins with macrotrichia above. All cells but anal open, no appendix at fork of third vein. Stigma pale yellowish. Apical and anal areas of wing and first basal cell lightly infuscated, and all cross-veins with large dark clouds.

Abdomen dark brown, black haired, but with the following patches of silvery white hairs. Small middorsal triangles on the first, second and fifth tergites, and a large patch on the fourth tergite. Lateral tufts on

the first, second and third tergites, smallest on the first. Sternum dark and dark haired.

Male.—Eyes bare, the area of large facets about one-half area of the small facets, the areas fairly well demarcated. Vertexal tubercle present. Antennae much more slender than in female. Mesonotum without white stripes or lateral white hairs, only the scutellum being white margined. Abdomen with small tufts of white hairs on second, fifth and sixth tergites, a large white haired patch on fourth tergite. No lateral white patches. Wings and other characters as in the female.

Holotype, female, Escobal, Colon Province, Panama, March 11, 1945, C. M. Keenan coll. *Allotype* male, Barro Colorado Island, C. Z., March 17, 1936, W. J. Gertsch coll. One female *paratype*, Cayuga, Guatemala, Schaus and Barnes coll., 1 female *paratype*, Punta Ricles, Golfito, Costa Rica, May 14, 1943, T. Aitken coll. *Holotype* to be deposited in M. C. Z., *allotype* in American Museum of Natural History, 1 paratype in U. S. National Museum, 1 paratype in author's coll.

This species does not seem very obviously related to other middle-American forms known to me, so I have refrained from trying to place it subgenerically. The disproportionately long proboscis is noteworthy.

Tabanus (Philipotabanus) inauratus sp. nov.

Female.—Length 13 mm., of wing, 11 mm. Frons about 7 times as high as basal width, slightly narrowed below, pale grey pollinose. Callus black, club-shaped, about half width of frons basally and extending as a raised ridge nearly to vertex. Vertexal tubercle prominent, with vestiges of 3 ocelli, and placed upon a triangular black denuded area. Subcallus dark grey pollinose. Face and cheeks dark grey pollinose, both with fairly numerous erect grey hairs. Eyes apparently unbanded, greenish black. Antennae black, black haired. First segment somewhat swollen, second with a long dorsal spine, third with the basal part longer than wide, longer than the annulate part and with a prominent though blunt dorsal angle. Palpi blackish, black haired, rather slender. Proboscis black, short, the large membranous labelli accounting for three-fourths of its length.

Mesonotum black, black haired on the disk, but with a patch of rich golden hairs on each side at the transverse suture, and with the whole posterior border of the mesonotum and whole scutellum densely clothed with rich golden hairs. Pleura and sternum black, grey pollinose, mostly black haired, except for tufts of white hairs beneath and above wing bases. Legs black, black haired, except a tuft of long white hairs on bases of fore coxae. Wings with subepaulet, costa, subcosta and first vein all with dense macrotrichia. Venation normal, no appendix on fork of third vein. Wing largely black, apex hyaline, basal cells yellowish hyaline, costal cell brown, anal area somewhat dilute blackish. Abdomen above mostly black and black haired, but sides of first and second tergites and a broad middorsal patch on fourth tergite silvery white haired. Venter wholly black.

Holotype female, Almirante, Bocas del Toro Prov., Panama, March 12, 1943, Marucci and Wood colls. One female paratype, Ft. Sherman Reservation, C. Z., March, 1945, Keenan coll. To be deposited in the Museum of Comparative Zoology, Cambridge, Mass.

This very striking species is an interesting and handsome addition to the Panama fauna. It seems most closely related to *T.* (*Ph.*) *fascipennis* Macq., from which it differs in the golden haired scutellum, broader frons, stouter palpi, and almost wholly clear basal cells of the wing.

Tabanus (Philipotabanus) magnificus Kröber

Three females, Almirante, Bocas del Toro Prov., March 12, 1943, 1 female, Chiriqui Point, Bocas del Toro Prov., April 1, 1943, and 1 female, Pito, Intendencia de San Blas, June 20, 1943, all Marucci and Wood colls.

Tabanus (Philipotabanus) keenani sp. nov.

Female.—Length, 11 mm., of wing, 11 mm. Frons narrow, a little over 7 times as high as basal width, narrower below, dark yellowish grey pollinose. Basal callus black, club-shaped, about half as wide as frons and extended upwards as a narrow raised line two-thirds of the distance to the vertex. Vertexal tubercle not prominent, represented by a small bare spot. Antennae yellowish orange throughout, the upper angle on the third segment poorly developed. Palpi slender, dark brown, black haired. Subcallus, fronto-clypeus and genae dull yellowish grey pollinose. Beard sparse, of mixed grey and black hairs and confined to the lower parts of the genae. Eyes bare, unicolorous, probably dark bronzy or greenish in life.

Mesonotum and scutellum light chocolate brown, the former sparsely black haired, the latter with pale hairs. Pleura dark grey with sparse dark hairs. Legs wholly black and black haired. Wings with subepaulet setose and no appendix on fork of third vein. Wing markings reduced to a discal patch below the stigma and including the whole discal cell and extreme bases of all posterior cells. The proximal halves of the basal cells and most of the costal cell are also brown. Abdomen black and black haired, the posterior margins of all tergites and most of the first tergites bluish white pruinose. Beneath, the pruinosity is more extensive.

Holotype female, near Piña, Colon Province, Panama, October 14, 1943, C. M. Keenan coll. To be deposited in the Museum of Comparative Zoology, Cambridge, Mass.

This species appears to connect in some ways the species, such as *medius* Kröb., having hyaline fenestrae about the cross-veins, with those in which the dark pattern is solid, like *fascipennis* Macq. The lack of fenestrae will separate it from any of the former group, while the greatly reduced pattern will distinguish it from *fascipennis* and its allies. Named in honor of the collector, Mr. C. M. Keenan, Assistant Sanitary Inspector for the Panama Canal Department.

Tabanus (Bellardia) albocirculus Hine[2]

Six females, Almirante, Bocas del Toro Prov., March 12, 1943, Marucci and Wood colls., August 18, 1944, Fairchild coll., and Robalo,

[2]Dr. Bequaert informs me that *Lophotabanus* Szilady is the correct name for this group, *Bellardia* Rondani 1863 being presumably preoccupied by *Bellardia* Rob.-Desv. 1863, in the Tachinidae.

January 21, 1946, P. Galindo coll. These are the darkest specimens seen from Panama, being nearly coal black in ground color, with heavily fumose wings. They are also much larger than specimens from the Pacific coast.

Tabanus (Hybomitra) quadripunctatus Fab.

A single female approaching the variety *amabilis* Walk. from Almirante, Bocas del Toro, March 12, 1943, Marucci and Wood colls.

Tabanus (Neotabanus) unistriatus Hine

Two females from near Almirante, Panama, August 21, 1944. This locality is on the Caribbean coast whereas the only previous known records in Panama were from the Pacific coast in Chiriqui Province.

Tabanus (Neotabanus) vittiger var. **guatemalanus** Hine

A single female from Mt. Hope, C. Z., June 28, 1944, Keenan coll., invalidates the statement (Fairchild, 1942, p. 181) that this form is confined to the Pacific coast of Panama, as Mt. Hope is on the Atlantic side.

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THE GENUS URANOTAENIA LYNCH ARRIBALZAGA IN PUERTO RICO

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The discovery of *Uranotaenia cooki* Root in Puerto Rico has made it desirable to restudy all stages of the three local species of *Uranotaenia*.

Uranotaenia Lynch Arribalzaga (1891) is such a well-defined genus that a number of authorities such as Dyar (2) and Neveu-Lemaire (8) have felt justified in making it the type genus of a distinct tribe Uranotaeniini in the subfamily Culicinae.

The adults are easily recognized by their small size, and the bluish-white scales on the thorax, abdomen, or basal portion of the wing. More fundamental characters visible with suitable magnification are the very fine microtrichiae in the wing membrane, the second marginal cell less than half as long as its petiole, the short anal vein which ends before the level of fork of Vein 5 (Cu), and the short palpi in both sexes. The female *Uranotaenia* have only one sclerotized spermotheca, in this respect resembling *Anopheles* and differing from most of the culicine genera.

The following key will serve to separate the adults of the three Puerto Rican species, the first two of which occur in southeastern United States:

KEY TO ADULT PUERTO RICAN URANOTAENIA

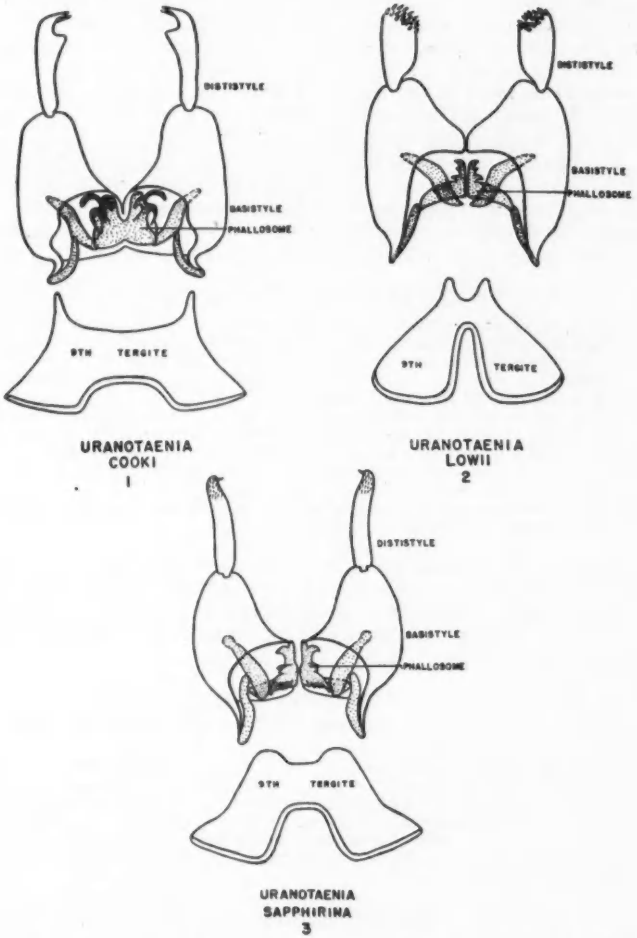
1. Hind tarsus with last two segments entirely white; tip of hind femur and hind tibia without or with small white spots; small species averaging 1.5 mm. long ..... **lowii**
   Hind tarsus entirely black, tip of hind femur and hind tibia with conspicuous white spot; larger species averaging about 2 to 3 mm. long 2
2. Mesonotum with narrow, median, longitudinal stripe of bluish scales; abdomen without white spots laterally; fore tarsus of male normal, **sapphirina**
   Mesonotum without median, longitudinal stripe of bluish white scales; abdomen with conspicuous white or bluish-white spots laterally; first segment of fore tarsus in male shorter than second segment ..... **cooki**

The male terminalia of the three Puerto Rican species of *Uranotaenia* are likewise very distinct. The important diagnostic characters are found in the shape of the dististyle (clasper), in the structure of the phallosome, and in the shape of the ninth tergites. A key based on characters of male terminalia is given below:

A KEY TO THE MALE TERMINALIA OF PUERTO RICAN URANOTAENIA

1. Dististyle (clasper) about as long as broad at apex, with 15 to 25 strong spines distally (fig. 2) ..... **lowii**
   Dististyle (clasper) nearly twice as long as broad with one terminal spine 2
2. Dististyle (clasper) but slight expanded in middle; phallosome plates with three short teeth; ninth tergite with short, rounded shoulders and narrow interlobar space (fig. 3) ..... **sapphirina**
   Dististyle (clasper) strongly expanded slightly beyond middle; phallosome plates with three long, curved, finger-like lobes; ninth tergite with longer, pointed lobes and broad interlobar space (fig. 1) ..... **cooki**

The larvae of *Uranotaenia* are often mistaken in the field for those of *Anopheles* because of the nearly horizontal angle at which they hang from the surface of the water. In the Nearctic and Neotropical regions



FIGS. 1 to 3. Male terminalia of the three Puerto Rican species of *Uranotaenia*.

all the species of *Uranotaenia* (except *U. anhydor* and *U. syntheta*) may be distinguished from all other Culicinae by their elongate, pear-shaped head with four, stout spines dorsally (the upper and lower head hairs

of American authors and the inner and mid frontal hairs, Nos. 5 and 6 some Old World authors).

The larvae in this genus are remarkably similar and great care must be taken in making specific determinations of this stage. Dyar (2) had noted the importance of the number of teeth on the sclerotic plates on abdominal segment VIII, while King, Bradley, and McNeel (6) have shown the value of upper lateral hair on abdominal segments I and II. More recently Pryor and Chamberlain (10) have shown that the length and number of branches in the No. 3 hair of the anterior, submedian, prothoracic group are important taxonomically, while Dodge (1) has found good diagnostic characters in the branching of prothoracic hair No. 13. The number of branches of the postclypeal hair (No. 4) also seems to have specific value. The characters given in the following key apply only to fourth stage larvae. Fourth stage larvae have the anal segment completely encircled by a sclerotized plate, whereas this plate never completely surrounds the segment in younger larvae.

KEY TO FOURTH STAGE LARVAE OF PUERTO RICAN URANOTAENIA

1. Upper lateral hair of abdominal segments I and II triple; postclypeal hairs single or double; branches of No. 3 hair of anterior, submedian, prothoracic group about half as long as Nos. 1 and 2 hairs; hair 13 of prothorax multiple (fig. 6) ..... **sapphirina**
   Upper lateral hair of abdominal segments I and II double (lower lateral hair single in all species) postclypeal hairs triple or multiple; branches of No. 3 hair of anterior submedian prothoracic group almost as long as Nos. 1 and 2 hairs; hair 13 of prothorax single 2
2. Comb scales on posterior edge of sclerotic plate usually 10 or more in number: head of live larvae usually golden brownish (fig. 4) ..... **cooki**
   Comb scales on posterior edge of sclerotic plate usually less than 10 in number, often 8; head of live larvae blackish (fig. 5) ..... **lowii**

The pupae of *Uranotaenia* differ from most other culicine pupae in having the part of the paddle inside of the mid-rib conspicuously wider than that outside. The shape of the respiratory trumpet is characteristic for each species. In addition the number of fine branches in abdominal hairs VIB and VIIB is of some use.

KEY TO PUPAE OF PUERTO RICAN URANOTAENIA

1. Respiratory trumpet short, about 3 to 5 times as long as diameter of middle portion of trumpet (fig. 7) ..... **lowii**
   Respiratory trumpet longer, 6 to 10 times as long as diameter of middle portion of trumpet 2
2. Respiratory trumpet with a broad, V-shaped truncation; hair VIB and VIIB with two strong branches and several finer ones (fig. 8) ..... **sapphirina**
   Respiratory trumpet with shorter truncation, and a very sudden, sharp V-shaped notch in the middle of truncation; hairs VIB and VIIB with several strong branches (fig. 9) ..... **cooki**

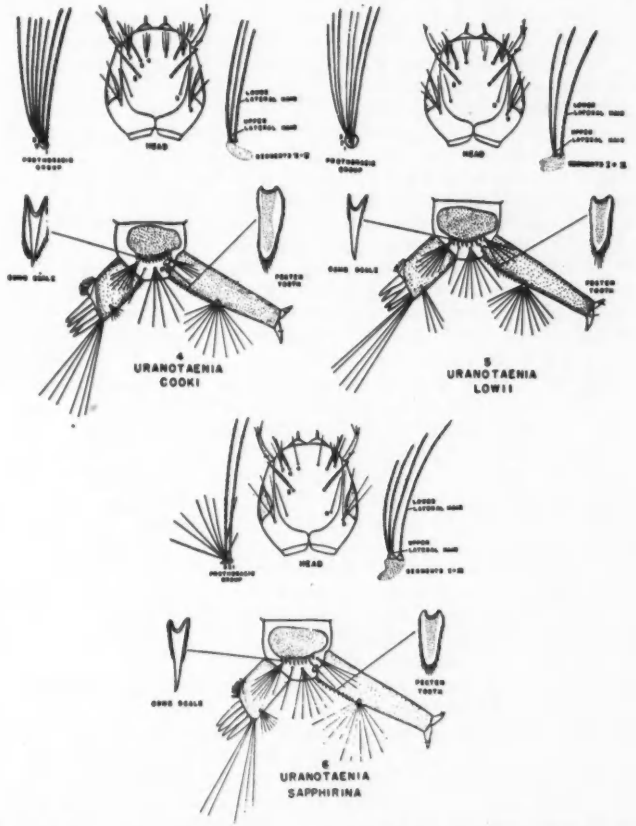
Uranotaenia cooki Root

Uranotaenia cooki Root, 1937, Journ. Par. 23: 98.
Uranotaenia cooki Pritchard and Pratt, 1944, Pub. Health Rpts., 59: 233.
Uranotaenia cooki Weathersbee, 1944, P. R. Journ. P. H. Trop. Med., 19: 643.

Recognition characters: Adult.—A small, delicate mosquito with bluish scales on thorax, wings, and base of abdominal segments laterally. It resembles *sapphirina* in size and dark hind tarsus, but has no

median line of bluish scales on the bronzy brown mesonotum. It is similar to *lowii* in having patches of silvery-blue scales laterally on the abdomen. The male is very distinct from either species in having the first segment of fore tarsus conspicuously shorter than the second.

Male terminalia: (fig. 1) Dististyle about twice as long as basal width, with a conspicuous swelling before tip, one apical spine on clasper;



FIGS. 4 to 6. Larval structures of the three Puerto Rican species of *Uranotaenia*.

phallosome plates with 3 long, curved, finger-like lobes. Ninth tergite with long, pointed lobes and broad interlobar space.

Larva: (fig. 4) Head elongate-elliptical, pear-shaped, light yellowish or golden-brown; preclypeal hairs (No. 1) short, stout, peg-like; post-clypeal hairs (No. 4) 3-branched; upper and lower head hairs (Nos. 5 and 6) single, stout, very slightly spicular under high magnification;

anteantennal hairs (No. 7) 5- or 6-branched; sutural hair (No. 8) single; trans-sutural hair (No. 9) 4- to 6-branched; antenna short, sparsely spicular, with a single hair at basal third. Anterior, submedian, prothoracic group with hairs all originating from a single sclerotic plate, the No. 3 hairs usually 6- to 9-branched, the branches nearly as long as No. 1 or No. 2 hairs. Hair 13 of prothorax single. Upper, lateral hair on abdominal segments I and II double, occasionally triple, lower lateral hair single. Long lateral hairs on abdominal segments III to VII multiple. Sclerotized lateral plate on eighth segment with a row of 10 to 14 teeth on its posterior margin, each tooth triangular, membrane with fringe on lateral sides more conspicuous than in ***lowii*** or ***sapphirina***. Air tube slightly tapered toward tip, about 5 times as long as basal width; pecten of 18 to 20 teeth not reaching middle of air tube, each pecten tooth long and slender, fringed on both sides with fringe longest at apex; a many-branched siphonal tuft just beyond pecten. Anal segment longer than wide, ringed by a sclerotic plate, with spines posteriorly, saddle tuft of 4 to 6 hairs; ventral brush posteriorly. Anal gills four, not quite as long as anal segment.

Pupa: (fig. 9) Respiratory trumpet longer than in ***lowii***, about the same length as in ***sapphirina***, but with a broader truncation apically and a sudden, sharp, V-shaped notch in middle of truncation.

Biology: Not much is known about the biology of *Uranotaenia cooki*. Capt. S. S. Cook told the writer that he collected adults under the bank of a rocky stream across from his home in Port-au-Prince, Haiti. Root (11) in his original description, quotes a letter from Capt. S. S. Cook describing the habitat as follows: "Flood waters erode the banks of the stream and leave jutting ledges of rock. In such places there are small pools of quiet water, constantly shaded and without vegetation, except for the rotting leaves. The adults rest on the under surface of the rocks and fly when disturbed, but immediately return to the dark hiding place."

The Haiti type locality is apparently similar to Los Chinos creek in Gurabo, Puerto Rico where the species has been found at an elevation of approximately 500 feet. In Gurabo no larvae were found, but the adults could be found on densely shaded, damp, mossy rocks in association with adults of *Culex* (*Micraedes*) *americanus* N. L. whose larvae breed in water collections in the axils of the leaves of malanga (*Caladium colocasia*).

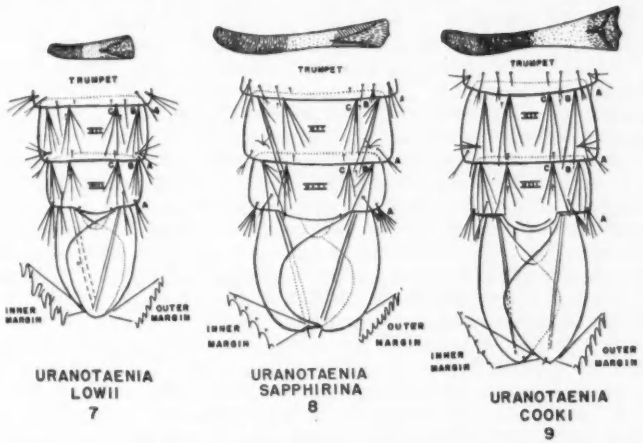
Capt. T. H. G. Aitken and the writer made the first recognized Puerto Rican collections of larvae of *U. cooki*. They were found with the larvae of *U. lowii* and *U. sapphirina* and *Culex opisthopus* Komp about 100 yards from the slaughter house in Barrio Palma, Km. 0.5, Catano, P. R. on Dec. 26, 1942. The water was clean, either in hoof prints or a narrow backwash along the edge of Aguas Claras creek, in most cases well-shaded by the semi-aquatic grass (*Leptochloa virgata*) and a smartweed (*Persicaria acuminata*). This is apparently quite a different habitat than the Haitian type locality of Los Chinos creek in Gurabo, P. R.

More recently *cooki* larvae have been found breeding throughout the year in the Alianza reservoir in Salinas, P. R. This is completely covered with such a dense growth of water hyacinth (*Piaropus crassipes*) that the water is very densely shaded. Associated mosquito larvae in this

reservoir are *Uranotaenia lowii* Theobald, *Uranotaenia sapphirina* (O. S.), *Culex atratus* (Theobald), *Culex chidesteri* Dyar, and *Anopheles vestitipennis* Dyar and Knab.

Although his specimens are not available for checking, it seems probable that *U. cooki* Root is the third species of *Uranotaenia* mentioned by Tulloch (13). A specimen of this species was taken in net collections in a thickly wooded area at Mayaguez, P. R., in May, 1936.

Adults have been collected in a light trap on the Fort Buchanan Reservation on February 9, 1943; at Carolina, P. R., in March and April, 1944; at Camp Tortuguero in March, 1943; and at Humacao throughout the year, Oct., 1944, to Oct., 1945. Capt. T. H. G. Aitken observed mating, end to end facing in opposite directions, in a lantern chimney approximately 5 inches in diameter and 6 inches tall, so *Uranotaenia cooki* is *stenogamous*, i. e., will mate in small containers.



FIGS. 7 to 9. Trumpets and terminal abdominal segments of the pupae of the three Puerto Rican species of *Uranotaenia*.

All the larvae of *cooki* collected in the field have had a characteristic golden-brown head, whereas *sapphirina* usually has a dark brown to blackish head, and *lowii* almost always has a blackish head.

Distribution.—Haiti: Port-au-Prince, type-locality. Puerto Rico: Humacao (R. E. Serfling); Ensenada Honda (A. Weathersbee and G. E. Bohart (14)), Loiza, Carolina, Catano, Gurabo, Vega Baja, Salinas, Ponce, (H. D. Pratt). Virgin Islands: Spring Gut Stream, St. Croix, Dec., 1934, H. A. Beatty (Det. Alan Stone, 1 female and 2 males in U. S. National Museum.)

Uranotaenia lowii Theobald

Uranotaenia lowii Theobald, 1901, Mon. Cul., 2: 339.

Recognition characters: Adults.—A small, delicate mosquito with bluish scales on thorax and wings. Mesonotum bronzy-brown, with a

darker spot on each side near base of wings. Abdomen with patches of bluish of white scales laterally. Wing scales brown, basal part of first and fifth veins with blue scales. Hind tarsus with last two segments white, tip of hind tibia dark.

Male terminalia: (fig. 2) Distisyle very stout, only slightly longer than broad, inner surface of distal half with a patch of 15 to 25 stout spines. Ninth tergite longer antero-posteriorly than in *cooki* or *sapphirina*, with pointed lobes and narrow interlobar space.

Larva: (fig. 5) Head much longer than wide, pear-shaped, blackish. Hairs Nos. 5 and 6 single, stout, minutely serrulate. Postclypeal hairs (No. 4) triple or rarely multiple; No. 3 hair of anterior, submedian prothoracic group with 5 to 7 branches almost as long as Nos. 1 and 2 hairs. Prothoracic hair No. 13 single. Upper lateral abdominal hair on segments I and II double. Lateral comb of eighth segment a row of approximately eight teeth on posterior margin of a chitinized plate. Anal segment ringed by sclerotized plate, posterior margin fringed with a row of fine spines. Air tube slender, straight, about three times as long as basal width; hair tuft multiple, about in middle of tube; pecten reaching to tuft.

Pupa: (fig. 7) Respiratory trumpet short, about three to five times as long as diameter of middle portion of trumpet.

Biology: Uranotaenia lowii is one of the commonest mosquitoes in light trap collections in Puerto Rico, 500 to 1000 specimens of both sexes sometimes being collected in a single, overnight catch. It is found in traps throughout the year most abundantly during the rainy season. Larvae occur in semi-permanent to permanent pools of water with algal mats vegetation, associated with larvae of *Culex*, *Anopheles*, *Corethrella*, and sometimes *Psorophora* or *Aedes*. It has been found at Catano, P. R., in marsh meadow pools about a week to ten days following flooding or heavy rainfall at the time when *Psorophora confinnis* and *Aedes tortilis* larvae had pupated and were emerging and *Culex nigripalpus* and *Anopheles albimanus* were replacing them in the ecological succession of species. Male and female specimens *in copula* end to end facing in opposite directions, have been collected on *Lemna* fronds or floating vegetation on the surface of the breeding places. Larvae occur throughout the year, perhaps in greatest numbers toward the end of the rainy season in November, December and January. The life cycle has not been completely worked out but the length of the larval and pupal stages in the laboratory suggests that a complete generation from egg to egg, requires two to three weeks. The females have not been found sucking human or animal blood in Puerto Rico.

Distribution: Dyar (2) reports the species from the Gulf States, Antilles, Panama, Ecuador, Colombia, Venezuela, Trinidad, the Guianas and Argentina. Caribbean records of interest include the following:

Vieques: Puerto Mosquito at liht gtrap May and June, 1943, (H. D. Pratt). Puerto Rico: Humacao (R. E. Serfling), Ceiba, Naguabo, Loiza, Carolina, San Juna, Rio Piedras, Catano, Guaynabo, Caguas, Gurabo, Vega Baja, Aguadilla, Lake Cartagena, Ponce, Juana Diaz, Salinas (H. D. Pratt), Mayaguez, Guanica, Rincon, Lake Cartagena (G. S. Tulloch (13)). Haiti: Port-au-Prince, Aug. 21, 1924. W. A.

Hoffman (Root (10)). Jamaica: Fort Simonds, Sept. to Dec., 1944. G. A. Thompson.

Uranotaenia sapphirina (Osten Sacken)

Aedes sapphirinus Osten Sacken, 1868, Trans. Amer. Ent. Soc., 2: 47.
Uranotaenia socialis Theobald, 1901, Mon. Cul., 2: 340.

Recognition characters: Adult.—A small, delicate mosquito with bluish scales on thorax and wings. Mesonotum bronzy-brown, with a narrow median line of metallic blue scales extending from anterior margin to scutellum, a lateral row of blue scales extending from base of wing to middle of mesonotum. Abdomen without patches of bluish or white scales laterally. Wing scales brown, basal part of first and fifth veins with bluish scales. Hind tarsus entirely black, tip of hind tibia with a large white spot.

Male terminalia: (fig. 3) Dististyle slender, about twice as long as wide, with scattered setae on apical half. Ninth tergite with short, rounded lobes and narrow interlobar space.

Larva: (fig. 6) Head much longer than wide, pear-shaped. Upper and lower head hairs (Nos. 5 and 6) single, stout, minutely serrulate when seen under high magnification. Postclypeal hairs (No. 4) single or double. No. 3 hair of anterior, submedian prothoracic group 7- to 11-branched, less than half as long as No. 1 or No. 2 hairs. Prothoracic hair No. 13 multiple. Upper lateral hair on abdominal segments I and II triple. Lateral comb of eighth segment a row of approximately eight teeth on the posterior margin of a flat, chitinized plate. Anal segment ringed by sclerotized plate, posterior margin fringed with a row of fine spines. Air tube slender, straight, three times as long as wide. Hair tuft multiple, about in middle of tube; pecten reaching to tuft.

Pupa: (fig. 8) Respiratory trumpet six to ten times as long as diameter of middle portion, with a broad, V-shaped, apical truncation. Hairs VI B and VII B with two strong branches and several finer ones.

Biology: Uranotaenia sapphirina occurs over most Puerto Rico throughout the year. It does not appear to be as common as *Uranotaenia lowii* and certainly it is taken less frequently in light trap collections. Male and female specimens have been taken mostly in light traps near the breeding places, suggesting a short flight range, possibly not more than half a mile. Larvae are found in clean, semi-permanent to permanent water containing emergent or floating masses of vegetation, or algal mats. The larvae have been found associated with the other two Puerto Rican *Uranotaenia*, the three Puerto Rican *Anopheles*, and several species of *Culex* larvae. It is most common in the upland and central portions of the Island, or in cool coastal marshlands. Lawlor (7) has written that in South Bethlehem, New York females hibernate over-winter, and Hinman (5) found millions inside Fort Jackson, Louisiana, during December, 1934 and January and February, 1935. He noted that these "females were very easily disturbed, suggestive of false hibertation." By March 27, 1935, no females could be found. In Louisiana larvae have been found in January, and from mid-March to

Sept. 18, suggesting hibernation either as larvae or adult females. In Puerto Rico breeding is continuous throughout the year.

Distribution: Eastern United States from New Hampshire and Minnesota south to Florida and Texas, Honduras, Antilles, and Virgin Islands. The following Caribbean records are of interest:

Virgin Islands: St. Croix (Hayes (4) as *Uranotaenia socialis*) St. Thomas, Estate Donoe, Jan. 3, 1920, Det. H. G. Dyar. From "Annual Rept. Commissioner of Health St. Thomas and St. John, V. I. Fiscal year 1919–1920" (unpublished). Vieques: Isabel Segunda, Esperanza, Dec., 1942, (H. D. Pratt). Puerto Rico: San Juan, Catano, Vega Baja, Arecibo, Aguadilla, Mayaguez, Cabo Rojo, Ponce, Juana Diaz, Aguirre, Humacao, Naguabo, Ceiba, Carolina, Caguas, Gurabo, Lares, (H. D. Pratt). Haiti: Carrefor, Cul de Sac, Mariani, Bon Repos, Sept. and Oct., 1924, W. A. Hoffman (Root (10)). Jamaica: Fort Simonds, G. A. Thompson.

ACKNOWLEDGMENTS

The writer wishes to acknowledge the interest and helpful suggestions of Senior Entomologist (R) G. R. Bradley and Sanitary Engineer (R) Porter A. Stephens of the U. S. Public Health Service, during the present study. Capt. Thomas H. G. Aitken and Mr. Jenaro Maldonado Capriles collected some of the material used in the present study and checked the value of taxonomic characters as they were gradually worked out.

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(11) **Root, F. M.** 1927. Note on the mosquito fauna of the Republic of Haiti. Am. Jn. Hyg., 7: 469.
(12) **Root, F. M.** 1937. A new species of *Uranotaenia* from Haiti. Jn. Par. 23: 98–100.
(13) **Tulloch, G. S.** 1937. The mosquitoes of Puerto Rico. P. R. Journ. Agr. U. P. R., 21: 137–168.
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NEW SPECIES OF NEW GUINEA URANOTAENIA OF THE TIBIALIS GROUP[1]

(Diptera: Culicidae)

WILLARD V. KING, Colonel,
AND
HARRY HOOGSTRAAL, Captain,
Sn. C., AUS

The five species of *Uranotaenia* described herein have in common a tuft of hairs or other structure at the tip of the fore tibia in the male, and in this respect resemble *U. tibialis* Taylor, of Australia. In addition, these species all have the following characteristics: male antenna sparsely plumose, the hairs fairly long; proboscis distinctly swollen at tip; head vertex with at least some white scales (bluish white in some lights); scutum dark, with fine dark scales except for a short lateral line of broad white scales in front of wing root; scutellum with broad dark scales; anterior pronotum covered with broad white scales, and a stripe of similar ones across the upper third of the sternopleuron; first fork cell very short (less than half as long as its stem), the scales broad and transparent; mid leg with an enlarged femur and a very long tibia (usually as long as the entire mid tarsus); segment 4 of mid tarsus of male very short, produced thumb-like underneath; segment 5 split apically into two lobes, with two long, slender, simple claws and a prominent empodium, all attached near the middle of the segment; fore tarsus with one claw bent at an angle, the other curved and much broader; hind tarsus white tipped, segments 4 and 5 being entirely white and segment 3 at least partly so; abdominal tergites all dark. The male genitalia are very similar in all five species and without good specific characters. The larva of three species are known and in each head hairs B and C are single thickened bristles, the antenna has two or three blade-like apical appendages and the lateral plates of the 8th abdominal segment are very large, nearly meeting above and below.

Besides differences in the tibial tufts and tarsal hairs, the relative lengths of the fore tarsal segments varies between each of the species, as illustrated in fig. 6.

Outside of the Australasian Region, the writers are aware of only two species (*U. delae* and *U. rayi* of the Philippines) with similar modifications of the fore tibia. These are referred to in connection with our species, *fimbriata*. Two or three other species such as *U. atra* have peculiar modifications of the male tarsi.

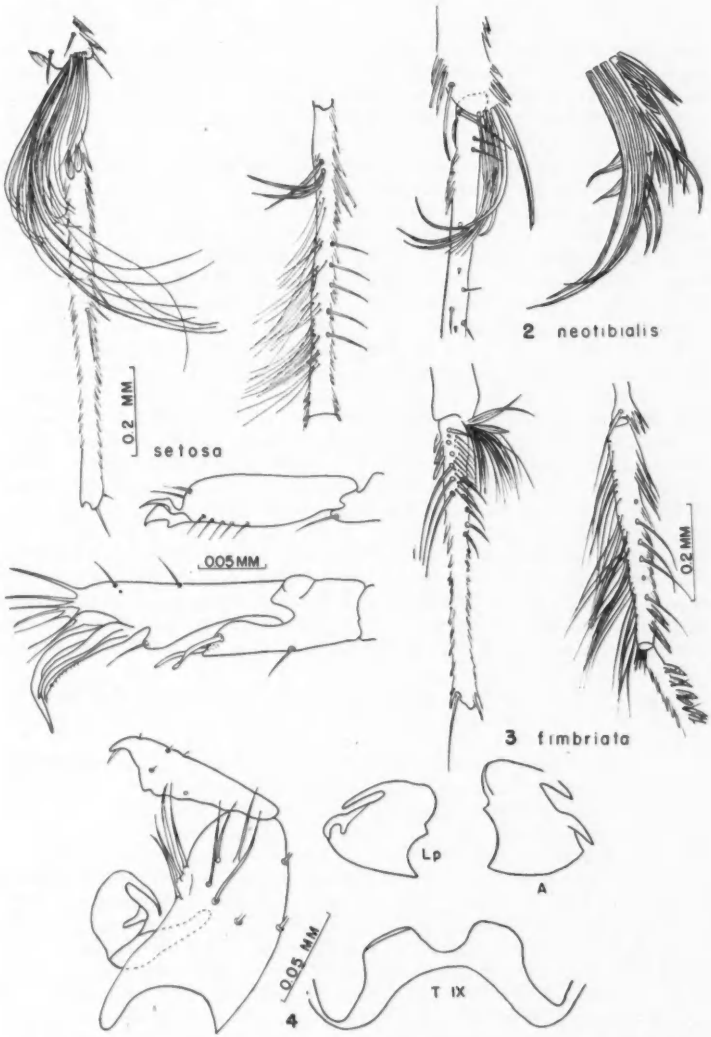
Uranotaenia setosa new species

Male holotype.—Proboscis 1.2 mm., with scattered short hairs on the swollen tip; palpus extremely short; antenna with 8–10 long hairs in each whorl; torus and clypeus dark brown; head (partly denuded) with

[1]From the 19th Medical General Laboratory, U. S. Army, contribution No. 13 from the Entomology-Mammalogy Department.

a median and submedian spot of white scales in front indicating a broad white stripe (paratypes usually with a rather narrow stripe, widening laterally); remainder of head vertex with flat black scales; no upright scales visible (two or three on nape in paratypes). Thorax dark; anterior pronotal lobe with broad white scales; scutum with fine dark scales except for a short prealar line of broad white scales; scutellum denuded (paratypes with flat dark scales); a rather broad stripe of white scales (3–4 scales wide) across sternopleuron. Wing 1.7 mm. Veins 1 and 5 without basal white (present in a single male of this species from Oro Bay); first fork cell less than a half as long as its stem. Fore femur slender. Fore tibia about three-fourths as long as femur, the expanded tip with a prominent tuft (fig. 1) on the outer side consisting of 12 or more very long hairs (nearly as long as the first tarsal segment if straightened out), and more numerous shorter ones, a little more than half as long. First tarsal segment about equal the tibia in length, with a stout bristle at the base, three bristles in a line about the middle of the segment, and two stout bristles and a short hair at apex; segment 2 (fig. 1) about .6 as long as 1, with long, pointed, slightly raised scales and with a fringe of numerous long hairs beginning a short distance from the base and extending nearly to apex (the length of this fringe somewhat variable in the paratypes); opposite these a line of five slender bristles beginning about the middle of the segment; segments 3 to 5 also with long pointed scales; segment 3 a little shorter than 1 and about a third longer than 2, with a ventral row of short hairs, bent at tips; segment 4 two-thirds as long as 3, a few short hairs along ventral side and an apical spine; segment 5 a fifth as long as 4, the claws equal in length but one bent at an angle, the other curved and much broader. Mid femur swollen basally; tibia about half again as long as the femur and twice as long as 1st tarsal; the latter about as long as the remaining four segments, with a double row of minute black thorn-like spines running the entire length of the segment, about eight stout bristles scattered along basal half and four at apex; segments 4 and 5 (fig. 1) very short; segment 4 produced below, with two curved spines at tip; claws of segment 5 long, slender and simple, attached subapically, one a little shorter than the other and about equal the length of the empodium. Segment 1 of hind tarsus slightly shorter than the hind tibia; segments 3–5 together about two-thirds as long as segment 1, pale scaled except for basal third of segment 3, which is darker; 5th segment .4 as long as 4th, the claws short, one a little broader than the other. Abdomen entirely dark above, slightly paler below. *Hypopygium* (fig. 7): Coxite short and broad with four close-set bristles about midway of inner margin, and scattered bristles elsewhere. Style broad, widest toward apex, then abruptly tapered on one side to a point; a few minute hairs on apical half and a pit on the inner margin at the widest point; a small subapical spine. Lateral plate of phallosome wide, with two ventrally directed teeth from the posterior edge, the upper one half as long as the plate, the lower shorter. Ninth tergite with the anterior margin deeply concave, and with two widely rounded posterior lobes, bare of hairs. Eighth tergite with a few bristles along posterior margin.

Female.—Antenna with about six hairs in each whorl, distinctly shorter than in male; first flagellar segment considerably longer than



Legs and genitalia of male: FIG. 1, tip of tibia, segments 1, 2 and 5 of fore tarsus and 4 and 5 of mid tarsus of *U. setosa;* 2, tibial tuft and apical portion of tuft of a second specimen (at higher magnification) of *U. neotibialis;* 3, tibial tuft and segments 1 and 2 of fore tarsus of *U. fimbriata;* 4, coxite, lateral plate of phallosome, and 9th tergite of *U. setosa*, and lateral plate (A) of *U. tibioclada.*

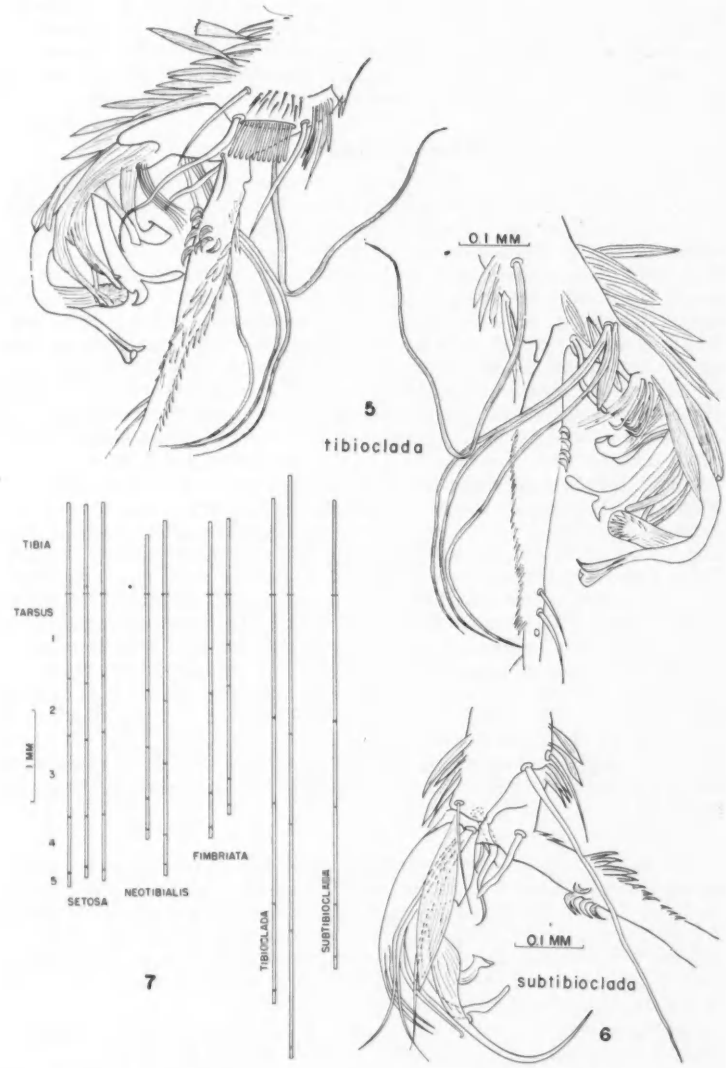
second. Head nearly covered with broad white scales except for a small median area behind; two upright scales visible on nape. Wing with short indistinct lines of pale scales on base of veins 1 and 5. Fore leg normal; the 1st tarsal segment slightly shorter than tibia; first segment of hind tarsus the same; last two segments and apical third of segment 3 of hind tarsus white. Other markings as in male.

Larva (fig. 8).—Antenna short, a few thick spines on shaft and a minute hair near middle; two blade-like leaflets subapically, another leaflet and a heavy spine at apex; preclypeal spine short and stout, set on a slight prominence. Head hair A two-branched, inserted back of antennal base; B and C single bristles, elongate and thick, fringed along sides with minute hairs, C well back of and slightly inside B; *d* a long single hair in line with and internal to B; *e* single, *f* small, with about 5 branches. Upper lateral hair on abdominal segment I and II 3-branched, the lower single; lateral and other hairs on segments III to VII very small. Segment VIII with a large sclerotized plate extending nearly the full length of the segment; from posterior edge of plate a single row of eight stout pointed scales, longest in the middle, each scale fringed laterally except on apical fourth. Pentad hairs 1 and 5 very small, with four or five branches, 2 and 4 single, 3 with five long lightly plumose branches; 1 and 2 set on a small sclerotized plate. Siphon short, index 2.0, the sides parallel, the apical valves very large; pecten of ten wide rounded scales, fringed apically and part way along sides; tuft large, with eight branches. Anal segment elongate, the saddle dorsally as long as siphon, shorter ventrally, its dorsal length a little less than twice its diameter; lateral tuft small, 4-branched; dorsal subcaudal hair with 5 or 6 subequal branches, the ventral hair with 2 longer branches; ventral tuft with 4 or 5 pairs of hairs, the posterior two 2-branched, the anterior single; anal gills slender, a little more than half as long as saddle.

Pupal siphon (fig. 8).—Long and slender (length .58 mm.; width at narrowest point .028 mm.), somewhat flared at tip, pigmented apically and on basal two-fifths.

Holotype.—Male (690–7), with slide mounts of genitalia, legs of one side of body, and larval and pupal skins; reared from larva collected at edge of a sago swamp, Hollandia, Netherlands, New Guinea, 12 Feb., 1945 (H. Hoogstraal and M. Brewer). *Paratypes.*—2 males (690–2, 690–14), 2 females (690–9, 690–6) with larval and pupal skins, and 1 additional slide of a larval and pupal skin (690–8), same collection as holotype; 1 female (932–1) with larval and pupal skins, from a ground pool in a swamp, Hollandia, 2 April, 1945 (H. Hoogstraal); 9 males taken by the writers in light-trap collections at Hollandia on January 21 and 25, April 2, 5, 11, 18, 23, and 26, and May 4, 1945; 1 male from a light-trap collection at Oro Bay, 1944 (17th Malaria Survey Unit). The holotype and part of the paratypes are deposited in the U. S. National Museum.

A number of females from light-trap collections at Hollandia and several reared from larvae (four in Lot 375 from a swamp pool 14 November, 1944, one in lot 1068 from a grassy ditch 5 May, 1945), were tentatively identified as this species. Since they were not directly associated with males and since the female is not known for all members of the group, their positive identification is not feasible.



Legs of male: FIG. 5, tibial appendage (inner and outer aspects) of *U. tibioclada;* 6, tibial appendage of *U. subtibioclada;* 7, relative lengths of fore tibia and tarsal segments of five species (the holotype being represented by the first drawing in each case).

The female of this species is similar to the type of *U. antennalis* Taylor, 1919, but the relation cannot be determined in the absence of the male of the latter. *U. antennalis* may in fact be the female of *U. tibialis* which was described from the same locality (Cairns, Aust.) at the same time. The status of these two species is discussed later.

Uranotaenia neotibialis new species

Male holotype.—Somewhat smaller than *setosa*; proboscis 1.0 mm., wing 1.4 mm. Head vertex with a rather large oval patch of white in front, dark elsewhere. Wing without visible white scales. Stripe of white scales on sternopleuron narrow. Prealar white scales present. Fore tibia about three-fourths as long as femur, with four pairs of spines along the shaft, one moderately long and two shorter bristles and a moderately long tuft at tip; tuft (fig. 2) composed of three dark, flattened, striated, curved, bristles, or modified hairs, about a fifth as long as the first tarsal, a number of hairs (at least one of which is also flattened) a little shorter than the first three, a long pointed scale about three-fourths as long on the outside, and two or three shorter scales. (In one of the paratypes, fig. 2, in addition to the three longest hairs, several of the shorter ones are seen to be flattened and tapered apically, and several others are still wider before the tip and end in a slender filament.) First tarsal 1.6 times as long as tibia; a long bristle at base, three short hairs subbasally, a row of minute thorn-like spines along most of segment, two stout bristles at basal fourth, three spaced along segment beyond this and two at apex. Segment 2 about .6 as long as 1 with two short hairs spaced on apical half and one at apex. Segment 3, slightly longer than 2 with about 5 short hairs spaced along segment and one at apex. Segment 4 about .4 as long as 3, and 5 about .4 as long as 4; tarsus with long, pointed scales. Mid tibia comparatively short for this group, 1.7 times as long as first mid tarsal and about .9 as long as whole tarsus. First hind tarsal a little shorter than tibia; segment 3 all white on one foot, slightly dusky basally on other. (One of paratypes has segment 3 all white, the other two have the basal half dusky but with the dividing lines very indistinct.) *Hypopygium:* very similar to *setosa.*

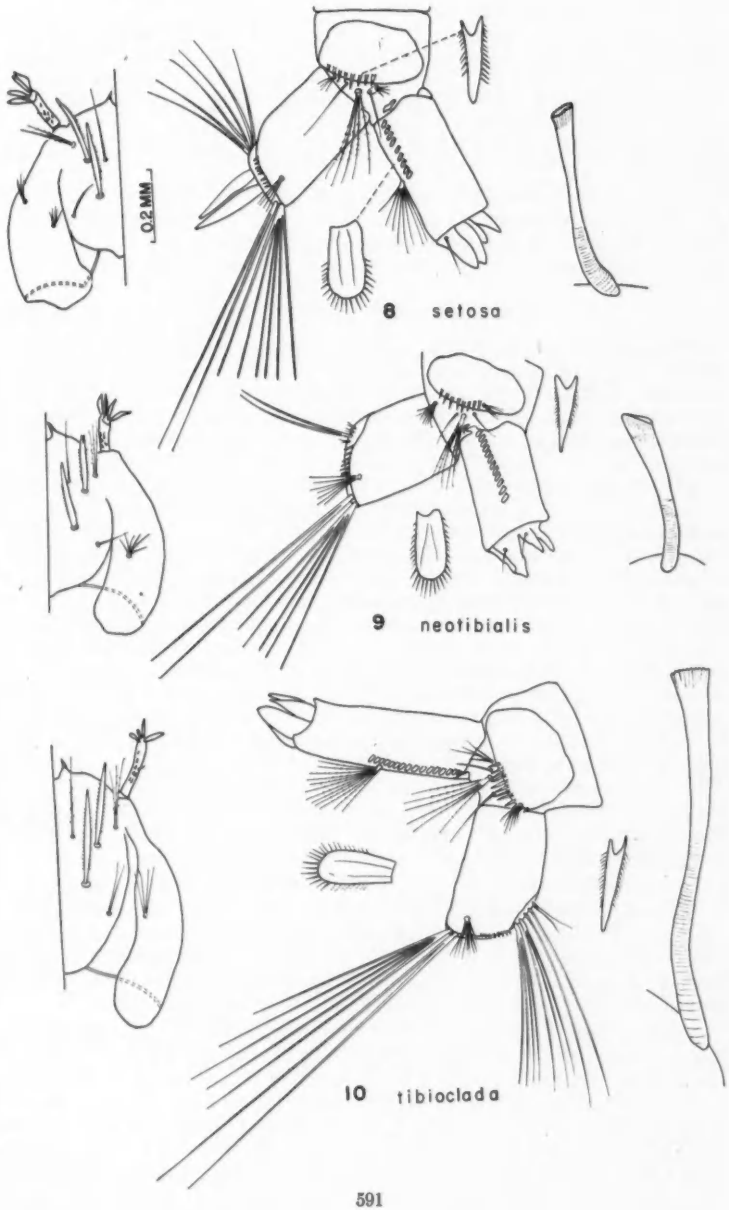
Female.—Unknown.

Larva (fig. 9).—Very similar to *setosa* except as follows: siphon shorter, index about 1.6; pecten with 12 scales, the distal one beyond the insertion of tuft; anal segment also shorter, index of saddle about 1.3, the ventral length less than diameter of saddle; lateral tuft of saddle 7-branched; pentad hair 5, 8-branched; head hair A 2- or 3-branched; hair B on one side forked at tip; abdominal segments III to VII with larger, multiple-branched hair tufts.

Pupal siphon (fig. 9).—Moderately long, length .46 mm., diameter .043 at narrowest point, pigmented apically and on basal half.

EXPLANATION OF PLATE III

Head and terminal segments of larva and siphon of pupa: FIG. 8, *U. setosa;* 9, *U. neotibialis;* 10, *U. tibioclada.*


0.2 MM
8 setosa
9 neotibialis
10 tibioclada

Holotype.—Male (826–1), with slide mounts of larval and pupal skins and one fore leg; reared from larva collected in a swamp ground pool in Hollandia, Netherlands New Guinea, 6 March, 1945 (H. Hoogstraal). *Paratypes.*—1 male (827–3) from another swamp pool at Hollandia 6 March (H. Hoogstraal); 2 males from a light trap at Hollandia, 22 March and 18 April, 1945; 1 slide mount (826–2) of a larval and pupal skin (of which the emerged male has been lost), same lot as holotype.

This species is probably the closest of the ones described herein to *U. tibialis* Taylor, so far as can be recalled by the senior author from a brief examination of the type before the fore leg was lost. The tarsus appeared more or less normal, without a thick fringe on the 2nd segment.

Uranotaenia fimbriata new species

Male holotype.—Proboscis 1.3 mm.; wing 1.5 mm. Head with a narrow line of white around eye margins, produced into a point between the eyes. Prealar white present; stripe on sternopleuron rather narrow; no white on wing. Fore leg characterized by a short tuft of hairs on tibia, a heavy fringe on the 2nd tarsal, very short 1st and 2nd tarsals and a very long 3rd segment. Tibia .7 as long a femur, with about 8 bristles spaced along shaft and a long one (possibly two) at apex; tuft (fig. 3) composed of about 20 short slender hairs, slightly flattened basally, a third as long as the 1st tarsal or a little longer. First tarsal two-thirds as long as tibia, with a row of six long bristles on basal third; opposite these a longer row of about 8 much shorter bristles; between these two a patch of about 20 fine hairs; a long bristle at apex. Second tarsal (fig. 3) .8 as long as first with a heavy fringe of long hairs along one side for nearly entire length (heavier than in *setosa*), the longest distal hairs nearly as long as segment, on opposite side a row of 5 or 6 shorter bristles. Segment 3 as long as 1 and 2 together (nearly equal length of femur); with short raised scales ventrally on basal third and a line of about 20 short slender bristles spaced along the segment. Segment 4 a third as long as 3 and segment 5 about a third as long as 4. Mid tibia equal in length to entire tarsus. Hind tibia a little longer than 1st hind tarsal. Segment 3 of hind tarsus dark on basal half or third, the demarcation from the white fairly distinct. *Hypopygium:* similar to preceding species.

Female and larva unknown.

Holotype.—Male (with slide mount of one fore leg), collected by the authors in a light trap at Hollandia, Netherlands New Guinea, 31 March, 1945. *Paratypes.*—2 males collected in a light trap by the 17th Malaria Survey Unit at Oro Bay, eastern New Guinea, 1945. The type is deposited in the U. S. National Museum.

Uranotaenia delae and *U. reyi* described from the Philippines by Baisis (Philip, Jl. Sc. 57: 68–80, 1935) have similar short tufts of hairs at apex of the fore tibia, and *delae* also has a short 2nd tarsal fringed with rather long hairs. This species, however, is without bristles at the base of the 1st tarsal, while *reyi* does not have the 2nd tarsal fringed and the abdomen has lateral white spots. The types of both these species were said to be females but it seems likely that the author was mistaken

in the sex. A paratype of *reyi* recently examined by the senior author in the U. S. National Museum is a male.

Among a series of specimens examined in the Museum from Bougainville and Guadalcanal, Solomon Islands, the fore legs of the males of one species were found to be very similar to *fimbriata*. The specimens differ, however, in having segment 3 of the hind tarsus entirely white, as well as the tip of segment 2, the white continuing underneath as far as the middle of the segment. The stripe of white on the head is wider (about four scales wide) and short lines of white are visible at the bases of veins 1 and 5.

Uranotaenia tibioclada new species

This and the following species differ from the preceding in the formation of a remarkable structure on the fore tibia, and also in having the fore femur as well as the mid femur enlarged. The specific names given to these species refer to the branched appearance of the tibia.

Male holotype.—A little larger than the preceding species, the legs distinctly longer, the proboscis relatively shorter. Wing 1.7 mm.; proboscis 1.2. Head almost entirely covered with broad white scales; prealar white scales present; none on wings. A narrow stripe of white scales across sternopleuron, continued across mesepimeron as a broad, pruinose, unscaled stripe. Fore femur swollen and similar in appearance to mid femur; fore tibia three-fourths as long as femur, also enlarged more than usual; a few scattered bristles on distal half; arising near the apex from the outer side a long, black, flattened, striated hair, bent sharply at about the middle, more than half as long as the tibia if straightened out; on the opposite side arising near the base of the comb is a moderately long, sinuous bristle and two shorter nearly straight ones. The apical appendage (fig. 4) consists of a semi-rectangular sclerotized basal portion, apparently articulated, from which arise a series of processes, most of which are darkly pigmented and curve back toward the 1st tarsus. These, in sequence, are as follows: a group of 3 long, black, flattened, striated, waved hairs and a pointed scale, attached on the outer side near base, the hairs reaching well beyond the apical process of the appendage; a covering of pointed scales on the lower edge followed by a pair of flattened appressed stems, the apex of one of which is recurved at tip; internal to the base of the latter, a tuft of hairs and a group of about six short bristles with the apical third bent at right angles, a long pointed scale also arises from the base of the bristles; two arms, the basal portions of which appear to be formed of several slender stems, the apical portions fused, one flattened and twisted at tip, the other semi-clubbed; a long smooth arm divided apically into a finger-like portion and a shorter curved beak; several flattened processes of which one is bluntly rounded at tip, three or four are pointed and one has a small tooth subapically; an apical arm divided about midway into a broad, flat, rounded process with a distinct laminated pattern, and two longer, appressed, flattened stems, one broadened and recurved at tip. Segment 1 of fore tarsus a third longer than the tibia, the basal fourth somewhat swollen, with a flattened sinuous bristle from extreme base, a tuft of short pointed scales, curved at tips, subbasally, three long bristles in line near end of the swollen portion, a line of minute thorn-

like spines along the remainder of the segment, and a long bristle at tip; 2nd segment .7 as long as first, with two slender bristles, well separated, near middle and several narrow erect scales and two or three very short bristles beyond these; 3rd segment a little longer than 1st, with three moderate bristles in a line near base and several fine bristles along shaft; 4th segment a little shorter than 3rd (about equal to 2nd) with a line of slender bristles along segment and a heavy one at tip; 5th segment about one-seventh as long as 4th. Mid tibia about twice as long as first mid tarsal, and equal length of entire tarsus; claws of 5th mid tarsal long, subequal, attached about middle of segment; empodium prominent with an unusually coarse fringe. Segment 1 of hind tarsus about equal in length to tibia; segment 3 entirely white. The paratype from a light trap collection at Hollandia is considerably larger than the type (wing 2.5 mm.; proboscis 1.7 mm.). The legs are distinctly longer, fig. 6, but the proportions are similar except that segment 4 of the fore tarsus is slightly longer than segment 3 (instead of slightly shorter). *Hypopygium:* Similar to preceding species; the upper tooth of the lateral plate is somewhat shorter (fig. 7A), reaching only to base of the lower tooth.

Female.—Similar to male except that the antennal hairs are shorter, the fore femur is only slightly widened, tip of tibia triangularly enlarged with a few elongate pointed scales; tarsus normal, the 1st segment as long as tibia.

Larva (fig. 10).—Antenna relatively longer than in preceding species; subapically a narrow blade-like leaflet and a shorter flattened one, at apex a thick bristle and a very short spine. Head hair A, 3-branched; B and C, single, thick; *d* long, single, slender; *e*, long, 2-branched; *f* long, 5-branched. Upper lateral hairs on abdominal segments I and II, 3-branched, the lower single. A large lateral plate on segment VIII with 12 pointed teeth on posterior edge. Siphon index nearly 3.0; pecten with about 16 scales, the last two beyond tuft, each scale wide, rounded and fringed. Anal segment completely ringed by plate, which is about 1.5 times as long as diameter of segment; lateral tuft small, about 8-branched; dorsal subcaudal hair with 5 branches, the ventral one with 2 longer branches; ventral brush with five pairs of hairs, the anterior one with 2 very short branches, the next two single, the last two 3-branched and 4-branched; anal gills missing.

Pupal siphon (fig. 10).—Very long and slender, length 1.05 mm., diameter .05 at narrowest point; pigmented on basal half and at apex.

Holotype.—Male (K156–4) reared from larva collected in ground pool in swamp near Samboga River, Dobodura, Eastern New Guinea, December, 1943 (W. S. Monlux), with slide mounts of terminalia, a fore and mid leg, and the larval and pupal skins. Deposited in U. S. National Museum. *Paratypes* (3 males, 3 females). One male taken by the authors in a light trap at Hollandia, Netherlands New Guinea, 4 February, 1945; 2 males, 3 females in the National Museum collection labeled "New Guinea APO 565, VIII–1–1944. E. S. Ross No. 120," this location being at Toem on the coast about 100 miles west of Hollandia.

The larvae in Lot 156 were associated with Larvae of *Culex* (*Neo-*

culex) *caeruleus* K. and H., *C.* (*Lophoceraomyia*) *fraudatrix* Theob., and *Uranotaenia* sp.

Uranotaenia subtibioclada new species

Male holotype.—Very similar to *tibioclada* except in the details of the tibial appendage and certain other characters as noted below. Head mostly denuded but the presence of a few scattered pale scales indicates that it may have been largely pale scaled. Proboscis 1.5 mm.; wing 1.8 mm. The most apparent difference in the tibial appendage (fig. 5) is found in the apical arm, the basal portion of which has a large bulbous swelling, while the apical portion extends as a stout curved, tapered rod and is not divided. Other differences from *tibioclada* are as follows: the long hair from near the apex of the tibia and the group of three hairs from the base of the appendage are not more than three-fourths as long; the basal portion of the appendage has a flattened pointed extension on the outer dorsal side; the medial group of bent bristles and tuft of hairs are apparently lacking; on the outside edge are two slender hairs in place of the flattened stems. The tarsal segments are very similar in length and conformation except that segment 4 is much shorter, being only about half as long (.54) as segment 3; the two bristles on segment 2 are placed near the apical third and there are no erect scales on this segment. The last three segments of the hind tarsus are entirely white as in *tibioclada*. *Hypopygium*: appears indistinguishable from *tibioclada*.

Female and larva unknown.

Holotype.—Male collected by the authors in a light trap at Hollandia, Netherlands New Guinea, 21 April, 1945 (with slide mounts of the terminalia and one fore leg). Deposited in the U. S. National Museum.

Uranotaenia tibialis Taylor

Uranotaenia tibialis Taylor, 1919; Proc. Linn. Soc. N. S. W., 43: 839. (Types, one male, two female from Cairns, Queensland, Aust.)

? *Uranotaenia antennalis* Taylor, 1919. Ibid., p. 840. (Two female types, also from Cairns.)

The salient characters given in the original description of the male of *tibialis* were as follows: head white except in center; a short prealar line of bluish white scales; pleura with bluish white flat scales; scutellum brown; abdomen black; apex of fore tibia with a tuft of long, brown, hair-like scales; 2nd tarsal with fairly long scales; hind tarsals 3 to 5 white. In 1944 the type male (No. 72 in the collection of the School of Hygiene and Tropical Medicine, University of Sydney) was removed for examination by Mr. Taylor and the senior author, at which time an accident to the specimen occurred resulting in the loss of the remaining fore and hind legs, before a detailed examination could be made. Neither of us could recall that the 2nd fore tarsal segment had a fringe of hairs, so it is not known whether the reference in the original description to "fairly long scales" referred to hairs or the semi-raised pointed scales found on the tarsi of these species, probably the latter. The specimen showed a median rectangular area of dark scales on the head, white elsewhere, and a few white scales at the base of vein 1. The senior

author's impression is that the species is nearest to ***neotibialis*** described herein. One of the type females (No. 75) has the hind tarsus all dark, so is not the same species. The hind legs of the second female (No. 77) are missing.

The principal characters given in the description of *U. antennalis* were: head with pale scales in center, blackish elsewhere; antenna brown, basal lobes yellowish, first segment very long, about twice the length of second, its base pale; thorax with a short prealar line of white; pleura brown with white scales; abdomen black, venter brown; apical tarsi pale. In the type female (No. 69, examined by the senior author in 1944) the head is somewhat shrunken but appears nearly all white except for a small dark area behind, the last two segments and tip (about one-fourth) of the third segment of the hind tarsus are pale, there is a broad stripe of white scales across the sternopleuron, and short lines of pale scales on the bases of veins 1 and 5. The long first flagellar segment of the antenna, for which the species was named, is not considered to be of specific value as a long first segment is usual in females of these species. The second female (No. 68) is unmarked except for a large patch of pale scales on the sternopleuron (tarsi and wings all dark, head denuded).

Further material from Cairns will be needed to clarify the taxonomy of these species. When this is done it is possible that one of the species described in the present paper will prove to be the same.

KEY TO MALES

1. Fore tibia with a long, bent hair near tip and a complicated apical appendage from which arise numerous processes, including a group of 3 long, waved hairs; 2nd fore tarsal not fringed; 3rd segment of hind tarsus all white; head scales nearly all white 2
   Fore tibia with an apical tuft of hairs only 3
2. Apical process of tibial appendage a single stout tapered rod with a bulbous base; 4th segment of fore tarsus about half as long as 3rd ..... **subtibioclada**
   Apical process of tibial appendage divided into 3 portions, the shortest one broad, flat and laminated; 4th segment of fore tarsus about as long as 3rd ..... **tibioclada**
3. Segment 2 of fore tarsus with a prominent fringe of long hairs; tibial tuft composed of slender hairs; head with a stripe of white around eyes 4
   Segment 2 not fringed with hairs; part of the hairs of tibial tuft distinctly flattened; 1st tarsal segment much longer than tibia and the other tarsals; head with an oval patch of white in front ..... **neotibialis**
4. Tibial tuft with some of the hairs nearly as long as the 1st tarsal; the latter longer than segment 3 and nearly as long as the tibia; with a short bristle near base and three in line near middle of segment **setosa**
   Tibial tuft with all the hairs short; tarsal segment 1 and 2 very short, the two together no longer than segment 3, which is unusually long (longer than tibia); 1st tarsal with a line of 6 long bristles near base, a second line opposite of shorter ones, and a patch of fine hairs in between ..... **fimbriata**

AN ECTOPARASITIC SURVEY OF MAMMALS FROM LAVACA COUNTY, TEXAS

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Maxcy (1926) first noted that rats and mice might be the reservoir of endemic typhus, and that fleas, mites, or ticks, were probable transmitters of the disease in the United States. Since that time, many investigators have recovered the rickettsiae of typhus fever from rats and their fleas. Dyar, Rumreich, and Badger (1931) first demonstrated the natural infection of the rat fleas, *Xenopsylla cheopis* (Rothschild) and *Leptopsylla segnis* (Schonheer) with endemic typhus. The fleas were taken from rats trapped in Baltimore, Md., and Savannah, Ga. Brigham (1941) reported the recovery of endemic typhus fever rickettsiae from naturally infected chicken fleas. Alicata (1942) obtained experimental transmission of the typhus rickettsiae from rat to rat with the sticktight flea, *Echidnophaga gallinacea* (Westwood). Dove and Shelmire (1932) reported the laboratory transmission of endemic typhus from guinea pig to guinea pig through the bites of tropical rat mites, *Liponyssus bacoti* (Hirst). Mooser, Zinsner, and Castaneda, working in Mexico City in 1930, obtained transmission from rat to rat by the rat louse, *Polyplax spinulosa* (Burmeister).

Due to the prevalence of typhus fever in south Texas an intensive murine typhus research program has been conducted since January, 1945, in Lavaca County, Texas. The Texas State Department of Health and the United States Public Health Service have been attempting to complete the epidemiological picture of murine typhus. Specialists trained in epidemiology, entomology, bacteriology, and mammalogy have been concerned with various aspects of the program.

This report concerns the results of an ectoparasitic survey of the mammals of Lavaca County, Texas.

The majority of the larger animals were taken by a trapper loaned to the program by the United States Fish and Wildlife Service. Dr. W. B. Davis, Texas A. & M. College Fish and Game Department, trapped and identified many of the rodents. All other specimens were trapped by personnel directly assigned to the typhus research program by the two cooperating agencies. All animals were taken alive, brought to the laboratory and bled. The ectoparasites were then removed, identified, and frozen under glass seal for laboratory animal innoculation.

Assistance was given in the identification of the ectoparasites by personnel of the United States National Museum, Washington, D. C., and the Rocky Mountain Spotted Fever Laboratory, Hamilton, Montana.

[1]The assistance of the following personnel of the Texas State Department of Health Laboratory is gratefully acknowledged: Frances Willard, Kellie O'Neill, E. G. Batte, and J. H. Sikes.

Class **Mammalia**

Order **Marsupialia**

Opossum—***Didelphis virginiana*** subsp. Twenty-seven examined.

SIPHONAPTERA

Orchopeas howardii (Baker)
Rhopalopsyllus coxi Eads
Ctenocephalides felis (Bouché)
Echidnophaga gallinacea (Westwood)
Pulex irritans Linnaeus
Xenopsylla cheopis (Rothschild)

ACARINA

Eulaelaps stabularis (Koch)
Liponyssus bacoti (Hirst)
Ixodes scapularis Say

Order **Carnivora**

Texas Raccoon—***Procyon lotor fuscipes*** Mearns. Thirteen examined.

SIPHONAPTERA

Rhopalopsyllus coxi Eads
Pulex irritans Linnaeus
Hoplopsyllus affinis (Baker)
Orchopeas howardii (Baker)
Cediopsylla simplex (Baker)
Echidnophaga gallinacea (Westwood)

ACARINA

Ixodes scapularis Say
Amblyomma americanum (Linnaeus)
Ixodes hearlei Gregson
Ixodes banksi Bishopp

MALLOPHAGA

Suricatoecus octomaculatus (Paine)

Striped Skunk—***Mephitis mesomelas mesomelas*** Lichtenstein. Three examined.

SIPHONAPTERA

Pulex irritans Linnaeus

MALLOPHAGA

Suricatoecus octomaculatus (Paine)

Grey Fox—***Urocyon cinereoargenteus*** subsp. Sixteen examined.

SIPHONAPTERA

Ctenocephalides canis (Curtis)
Echidnophaga gallinacea (Westwood)
Pulex irritans Linnaeus
Orchopeas howardii (Baker)
Rhopalopsyllus coxi Eads
Hoplopsyllus affinis (Baker)
Cediopsylla simplex (Baker)

ACARINA

Amblyomma americanum (Linnaeus)
Dermacentor variabilis (Say)
Ixodes scapularis Say

Texas Red Wolf—***Canis rufus*** (Audubon and Bachman). Four examined.

SIPHONAPTERA

Pulex irritans Linnaeus
Echidnophaga gallinacea (Westwood)
Rhopalopsyllus coxi Eads

ACARINA

Ixodes scapularis Say
Amblyomma americanum (Linnaeus)

Domestic Dog—*Canis familiaris*. One hundred and thirty-two examined.

SIPHONAPTERA
Pulex irritans Linnaeus
Ctenocephalides canis (Curtis)
Ctenophalides felis (Bouché)

MALLOPHAGA
Trichodectes canis Degeer

ACARINA
Amblyomma americanum (Linnaeus)
Amblyomma maculatum Koch
Dermacentor variabilis (Say)
Rhipicephalus sanguineus Latreille

Domestic Cat—*Felis domestica*. Ninety-five examined.

SIPHONAPTERA
Echidnophaga gallinacea (Westwood)
Ctenocephalides felis (Bouché)
Leptopsylla segnis (Schonherr)
Xenopsylla cheopis (Rothschild)

Order **Rodentia**

Texas Pocket Gopher—*Geomys texensis* Merriam. Seven examined.

MALLOPHAGA
Geomydoecus geomydis (Osborn)

ACARINA
Atricholaelaps sigmodoni Strandtmann

Fox Squirrel—*Sciurus niger limitis* (Baird). Sixteen examined.
Grey Squirrel—*Sciurus carolinensis* subsp.

SIPHONAPTERA
Orchopeas howardii (Baker)

ANOPLURA
Neohaematopinus sciurinus (Mjoberg)
Hoplopleura sciuricola Ferris

ACARINA
Amblyomma americanum (Linnaeus)
Ixodes scapularis Say
Atricholaelaps sigmodoni Strandtmann

Field Mice—*Baiomys taylori* subsp. One hundred and forty-seven examined.
Peromyscus leucopus texanus (Woodhouse). Twenty-three examined.
Perognathus sp. Two examined.

SIPHONAPTERA
Trichopsylla ironsi Eads[2]

ACARINA
Amblyomma americanum (Linnaeus)
Ixodes sp.
Eulaelaps stabularis (Koch)
Atricholaelaps sigmodoni Strandtmann

Cotton Rat—*Sigmodon hispidus texianus* (Audubon and Bachman). Ninety-four examined.

ANOPLURA
Hoplopleura hirsuta Ferris

ACARINA
Atricholaelaps sigmodoni Strandtmann
Ichoronyssus sp.
Liponyssus bacoti (Hirst)
Amblyomma americanum (Linnaeus)

[2]Description of species accepted for publication by Annals of the Entomological Society of America.

Wood Rat—*Neotoma floridana* subsp. Thirteen examined.

ANOPLURA
Hoplopleura hirsuta Ferris

ACARINA
Liponyssus bacoti (Hirst)
Amblyomma americanum (Linnaeus)
Atricholaelaps sigmodoni Strandtmann
Haemaphysalis leporis-palustris Packard

House Mouse—*Mus musculus musculus* Linnaeus. One hundred and fifty-five examined.

SIPHONAPTERA
Leptopsylla segnis (Schonherr)
Xenopsylla cheopis (Rothschild)
Echidnophaga gallinacea (Westwood)

ANOPLURA
Polyplax spinulosa (Burmeister)

ACARINA
Liponyssus bacoti (Hirst)

Domestic Rat—*Rattus rattus* subsp. Seven hundred and fifty-three examined.

SIPHONAPTERA
Pulex irritans Linnaeus
Nosopsyllus fasciatus (Bosc)
Echidnophaga gallinacea (Westwood)
Xenopsylla cheopis (Rothschild)
Leptopsylla segnis (Schonherr)
Ctenocephalides felis (Bouché)
Ctenocephalides canis (Curtis)

ACARINA
Liponyseus bacoti (Hirst)
Laelaps hawaiiensis Ewing
Eulaelaps stabularis (Koch)
Echidnolaelaps echidninus (Berlese)
Dermanyssus gallinae Redi
Ixodes sp.

ANOPLURA
Polyplax spinulosa (Burmeister)

Texas Cottontail—*Sylvilagus floridanus* subsp. Seven examined.

SIPHONAPTERA
Hoplopsyllus affinis (Baker)
Echidnophaga gallinacea (Westwood)

ACARINA
Haemaphysalis leporis-palustris Packard
Echinolaelaps echidninus (Berlese)
Listrophorus sp.
Atricholaelaps sigmodoni Strandtmann

Order **Artiodactyla**

White-Tailed Deer—*Odocoileus virginianus* subsp. Two examined.

DIPTERA
Melophagus ovinus Linnaeus

ACARINA
Amblyomma americanum (Linnaeus)
Ixodes scapularis Say

Order **Xenarthra**

Texas Armadillo—*Dasypus novencinctus texanus* (Bailey). Three examined.

SIPHONAPTERA
Rhopalopsyllus coxi Eads

Order **Chiroptera**

Mexican Free-Tailed Rat—*Tadarida mexicana* (Saussure). Thirty-four examined.

SIPHONAPTERA	ACARINA
Sternopsylla sp.	*Chiroptonyssus texensis* Augustson
	Ornithodoros sp.

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THE SALTICIDAE (SPIDERS) OF PANAMA, by ARTHUR M. CHICKERING. Bull. Mus. Comp. Zool., Harvard College, 97, pp. 1-474, 432 figs., 1946.

Dr. Chickering's monumental volume on Salticidae of Panama is a milestone in the study of the American faunas. Based on material he collected in Panama, this paper on "jumping spiders" (formerly Attidae) adds eighty species and fourteen genera to the known number of species from that country. Both the new material and many heretofore inadequately known species are described in detail and illustrated with line drawings. The descriptions are well arranged and documented with measurements, spination of legs, and color of specimens in alcohol. The general arachnologist would find the work easier to follow had complete documentation of synonomic references been included as well. Keys to species, genera, and groups of genera aid in placing spiders of the family.

It is hoped that Dr. Chickering will supplement his excellent systematic monograph with an analysis of the ecological and zoogeographical relationships of the Salticidae of Panama.—HARRIET EXLINE FRIZZELL.

BIOLOGY OF A PEST MOSQUITO COMMON IN NEW GUINEA[1]

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Among the more important mosquitoes affecting the health of natives and newcomer alike in New Guinea and adjacent islands is *Aedes scutellaris scutellaris* (Walker). Its characteristics as a pest alone class this as a mosquito of importance. The fact that this is a bold and persistent feeder during daylight causes it to be noticed more than other furtive species that feed after dark. This mosquito was especially annoying at army installations during the early stages of construction and was always a greater or lesser problem as the amount of rainfall was more or less. Opportunity to study this species was afforded at Oro Bay, New Guinea, and near Bosnek, Biak, in the Schouten Group during 1944 and 1945.[2]

RANGE AND HABITAT

Aedes scutellaris scutellaris[3] is widely distributed over New Guinea and adjacent islands. In the course of these observations it was collected at Milne Bay, Oro Bay, and Hollandia, all on the north shore of the main island and on Biak. The general distribution of the species in this group has been discussed by Farner and Bohart (1945) and by Stone and Farner (1945).

Frequent and numerous field collections show that *Aedes scutellaris scutellaris*, like others of the subgenus, *Stegomyia*, develops largely in small containers of water. Holes in trees and fallen plant parts, especially large leaves of forest trees, provide larval sites under natural conditions. Artificial containers such as cartons, coconut hulls, discarded shoes, tires, barrels, cans, gutters and canoes provide additional larval sites near human habitation. These and even more extensive larval sites are present in army camps. Huge piles of boxed parts for aeroplanes in a supply dump on Biak gave rise to one very annoying outbreak of this mosquito. Another outbreak on the same island came from an exposed dump of several thousand salvage tires. An unexpected source of a minor outbreak was bilge water in the hulls of amphibious

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[1]Research Paper No. 818, Journal Series, University of Arkansas. Published with permission of the Director of the Arkansas Agricultural Experiment Station.

[2]Authors and assistants were members of the 17th Malaria Survey Detachment, Army of the United States, at the time these observations were made.

[3]*A. variegatus* (Dol.) is a common synonym. The New-Guinea subspecies is said to be identical with *A. scutellaris hebrideus* of New Hebrides and is sometimes referred to under this name. Whether the correct name for the New-Guinea subspecies is *scutellaris* or *zonatipes* (Walker) has not been determined with certainty. Recent studies of the Australasian species of this group have been published by Farner and Bohart (1945) and Stone and Farner (1945).

aircraft. No larvae were found in cans or bottles with narrowly constricted tops.

Certain kinds of artificial containers were found to be preferred for larval sites as was shown by examination of 236 naturally infested ones removed from rubbish dumps. Paper cartons contained an average number of 74 larvae each while metal containers had an average number of 43 larvae each. Variation existed in suitability of different metal containers also. Those that were lined with lacquer had an average number of 63 larvae each while those that had been blackened by burning had only 32 larvae to the average can. This contrast in suitability of cans for larval sites was further demonstrated by a test with selected cans. The test consisted of four 12-ounce cans with lacquer linings, four without linings and four of each that had been heated to a dull red glow in an open fire. The 16 cans were partly filled with water and placed in the edge of a woods where they were examined and larvae removed once each week. At the expiration of a 63-day interval, 300 larvae had been removed from the four cans with lacquer linings, 94 larvae had been taken from the unlined cans, and only one larva had been found in the eight burned cans.

LIFE HISTORY

General.—*Aedes scutellaris scutellaris* has about the same general life history as other members of the subgenus, *Stegomyia*. Eggs are deposited singly on water or suitable moist surfaces. Often eggs adhere to the walls or debris where they may remain in a viable state weeks or possibly months. Larvae spend much of their time cruising along sticks, walls or debris raking the surfaces with their mouth bristles in order to dislodge minute particles of food. Larvae grow rapidly and are ready to pupate in about a week. Adults usually feed several times during their normal span of two or more weeks.

Egg Stage.—Eggs of this species are shiny black, about 0.75 mm. long and slightly less than half as much in diameter. They float readily on the surface film but will sink when wet.

The egg stage showed considerable variation in duration of incubation period for several groups treated in the laboratory. Those kept continuously on or in water from the time they were deposited required from two to 21 days for incubation, and the mean duration was 5.0 ± 0.3 days for 849 eggs as is shown in Table I. Eggs laid on moist surfaces did not hatch until flooded. One group was viable after 61 days in a moist chamber. In order for eggs to remain viable so long they must have been incubated on a wet surface long enough for the embryo to develop to the hatching stage. Examination of 84 eggs one to four days old showed that most embryos had the external features developed within 48 hours after deposition. By the end of the third day all seemed to be fully formed.

Larval Stage.—Superficially a larva of *A. scutellaris scutellaris* resembles those of other *Stegomyia*. It is slender with distinct constrictions between abdominal segments, and, in an active larva, the thorax is only slightly greater in width and depth than the abdominal segments. A larva moves more by rhythmic undulations than by rapid

convulsive jerks characteristic of less tenuous larvae. At rest at the surface a larva is suspended nearly vertically from its short broad siphon. When disturbed it will wriggle rapidly to the bottom where it will secrete itself in any debris present. Larvae shun strong light and will usually rest on the darker side of a container exposed to such light.

Larvae reared in the laboratory, where the temperature ranged between 75 and 90 degrees Fahrenheit, required four to eight days and a mean of 5.2 ± 0.1 days for completion as is shown in Table I. The mean duration of each of the first three instars was slightly over one day; the fourth instar required two days on the average.

Pupal Stage.—The pupal stage required one to three days and a mean of 2.0 ± 0.1 days when reared in the laboratory. Under field conditions this was often shortened to one day in large containers exposed to direct sun.

TABLE I

DURATION OF IMMATURE STAGES OF *Aedes scutellaris scutellaris* IN LABORATORY, BIAK, NETHERLANDS EAST INDIES, 1944

STAGE	NUMBER	DURATION		
		Maximum	Minimum	Mean
		Days	*Days*	*Days*
Egg	849	21	2	5.0 ± 0.3[4]
First instar	356	2	1	1.0 ± 0.1
Second instar	356	3	1	1.1 ± 0.1
Third instar	356	3	1	1.1 ± 0.1
Fourth instar	356	4	1	2.0 ± 0.1
Larval stage	356	8	4	5.2 ± 0.1
Pupa	356	3	1	2.0 ± 0.1
Larva and pupa total	356	10	6	7.2 ± 0.1

[4]Standard Error.

Adult Stage.—Adults may be observed in the woods near their larval sources almost any time during the day. They are especially active and eager to feed early in the morning and late in the afternoon. Both males and females may be active at such times. Males have been observed to hover in sunlit spots in the woods. As the females approached to feed they would be seized by the males and mating followed. Females intent on feeding approached boldly and were deliberate in choosing feeding sites. Exposed parts of the body or parts bound tightly by clothing were especially suitable feeding sites. Females tended to feed in greater numbers in absence of wind, but even moderate breezes would not prevent feeding. However, strong wind drove the pests to cover.

Adults live as long as six weeks in the laboratory. The mean longevity for 33 females was 21.9 ± 1.5 days in cages where an opportunity to feed was afforded daily. Mating took place usually on the first or second day after emergence. The preoviposition period was about seven days but was extended to 25 days in one case. From

one to seven batches of eggs or a mean of 86 ± 9 eggs were laid by each of these mosquitoes. One female deposited 218 eggs in 20 days. The mean number of blood meals consumed was 10.4 or nearly one meal every two days.

Females may lay eggs in a meniscus about an emergent or floating object or about the margin at or above the water level. Caged females provided with a bowl lined with filter paper laid most of the eggs on the moist paper above the meniscus. Two were observed ovipositing late in the afternoon in an exposed bowl containing slightly foul water and moist pellets of mud just above the water line. Both of them laid their eggs in the moist mud. Other eggs laid previously were placed in some marginal floating debris.

The effective flight range of this mosquito is not known exactly, but it seems to be less than three-quarters mile normally. Observation on relation between annoyance in camps and larval sites showed that the normal flight is less than 800 yards. For instance, personnel of one isolated unit on Biak was much annoyed by an outbreak arising from mountainous piles of boxes in a nearby supply dump. The pests were most abundant in the tents on the near side of the camp and within 100 yards of the source. Personnel stationed on the far side of the camp and no more than 800 yards from the source, reported no annoyance. Another instance is that of two small units separated by about 800 yards. Personnel of one was greatly annoyed by an outbreak arising from a small dump of discarded paper ammunition cartons in the unit area. Personnel of the farther camp reported no annoyance.

Actual observed range of individual mosquitoes was at least 1500 feet. A total of 5757 stained mosquitoes were released at intervals of 500 feet from retrieving stations on Biak between 31 December, 1944, and 22 January, 1945. Different stains applied as powdered dye diluted with flour were used to mark mosquitoes released at each of four places. Releases were made one or more times each day, according to the rate of emergence in the laboratory. Retrieving stations consisting of one man in a tent or peripheral woods nearer points of release than other sources of human blood were operated daily between 4:45 and 5:45 P. M. All mosquitoes attracted to the collector were caught in killing tubes for later examination. Collected specimens were placed on dry white filter paper in a petri dish and were moistened with a drop of 95 per cent alcohol. Any particle of stain present was dissolved and absorbed on the filter paper as a diffused spot below the mosquito that had borne it. Mosquitoes were retrieved from all points of release from zero to 1500 feet distant. Two were retrieved from 2737 specimens released at the 1500-foot point on the sixth and ninth days after the last releases were made.

SUMMARY

1. One of the most annoying pest mosquitoes in New Guinea and adjacent islands is *Aedes scutellaris scutellaris* (Walker). It is a sylvan species that is adaptable to domestic conditions. Larval sources include collections of water in plant parts and artificial containers. Exposed supply and salvage dumps about army camps provide abundant

larval sites. Bilge water in the hulls of amphibious aircraft provided one unusual source.

2. Metal containers varied in suitability as larval sites. Those with lacquer linings were more important than those without. Prior burning of metal containers made them decidedly less desirable as larval sites.

3. Developmental stages required for completion a little less than two weeks on the average. Egg stage and larval stage each required about five days, and the pupal stage required about two days. The egg stage was prolonged 61 days in the laboratory by keeping eggs in a moist chamber before submersion.

4. Adults are local in habits and tend to remain in the vicinity of their larval sites. Marked females have been collected 500 yards from point of release, but annoying numbers did not travel 800 yards as was observed in two different areas. Moderate breezes do not prevent feeding, but strong ones keep the mosquitoes from coming out.

5. Adults may live six weeks in the laboratory. Several batches of eggs may be laid by one female, and the mean number of eggs was 84 ± 9 for caged females. Eggs are laid in a meniscus about emergent or floating objects, or they may be laid on moist surfaces above water level.

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DISPERSION OF SMALL ORGANISMS, DISTANCE DISPERSION RATES OF BACTERIA, SPORES, SEEDS, POLLEN, AND INSECTS; INCIDENCE RATES OF DISEASES AND INJURIES, by D. O. WOLFENBARGER. Reprinted from The American Midland Naturalist, Vol. 35, No. 1, pages 1–152, January, 1946. The University Press, Notre Dame, Indiana. Price $1.00.

It is a satisfaction to read such a thorough and scholarly discussion of a subject with which all biologists must be concerned and about which most of them probably know very little. Following a brief introduction devoted chiefly to the definition of terms and description of methods the article is divided into two main sections, one of 102 pages on dispersion and incidence rates and the other on generalizations which completes the article with the exception of a brief appendix, nine pages of bibliography and an index. The first section includes discussions of large numbers of specific examples abundantly illustrated with graphs. Some reduce familiar conjectures to a scientific basis while others introduce striking data at variance with what might have been expected. The perusal of these records is to be recommended heartily. The author's analysis and discussion of the data in the second part of the article distinguishes between migration and dispersion and considers very thoroughly the factors involved in true dispersion. It is too compactly written to be summarized in a brief review, but the entire study is worthy of a place in the library of all biologists—and not merely of shelf room but of careful reading. Since a large number of the specific organisms considered are insects the work will be especially interesting to entomologists.—A. W. L.

NEW HEPTAGENINE MAYFLIES

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This paper presents descriptions of five new species of mayflies belonging to the subfamily Heptageniinae. Three of these species are from Illinois, one from Indiana, and one from Maine. They were segregated from material in the collection of the Natural History Survey; all the types are deposited in the Survey collection. The types of most of the previously described species, which are mentioned in comparing and differentiating these new species, were studied in 1942. Study of these types was made possible by travel funds supplied by the Illinois Natural History Survey.

Genus **Iron** Eaton

Iron namatus new species

Male.—Length of body 9–11 mm., of wing 9–11 mm. General color light brown, with light yellowish-brown or dark brown markings. A member of the *longimanus* group of species. See McDunnough (1938) for notes on the synonymy of the species in this group.

Head yellowish-brown, with variable obscure darker shading between lateral ocelli and antennal bases, and on vertex just dorsal to ocelli; frontal shelf obscurely darkened on meson; antennae tan, darkened at base of flagellum; ocelli black at bases; compound eyes pearl gray, contiguous on meson. Thoracic notum brown, light yellowish-brown at lateral margins, apices of meso- and metanota dark brown except on meson at apices of meso- and metascutella; pleura and sternum brown; mesonotum darkened at anterior margin, and a narrow, oblique, dark brown line on pleuron anterior to base of forewing. Pronotum brown, darker at posterior margin on meson, a short, oblique dark brown line present at each lateral margin; foreleg light brown, a dark brown median spot on femur, and minute dark brown area at base of femur, apex of tibia, and at each tarsal articulation; relative proportions of parts of foreleg; femur 30, tibia 40, first tarsal segment 18, second 16, third 16, fourth 11, fifth 6. Wings hyaline, veins light brown, crossveins in costal interspace wanting at base, weak and incomplete in midregion, well developed in stigmatic area, these costal crossveins almost hyaline, slightly milky; other crossveins in fore- and hindwing light brown; stigmatic crossveins slanted, not anastomosed. Middle and hind legs light brown, conspicuous dark brown median spot on femora. Abdominal tergites dark brown, lighter near anterior margin, so as to give abdomen an annulated appearance; antero-lateral angles light yellowish-brown. Sternites light brown, darkened at posterior margins. Apical abdominal tergites yellowish-brown, dark brown at posterior margins. Genitalia brown, forceps gray-brown; tails uniformly very dark gray-brown, almost black. Penis lobes, fig. 3, with relatively small, weak median spines, apical

notch of each penis lobe narrow, shallow; projection on inner, mesal margin of penis lobes rounded.

Female.—Length of body 9–11 mm., of wing 11–13 mm. Generally slightly lighter in color than male, with brown of male replaced by yellowish-brown, and light yellowish-brown areas of male becoming almost white in female. Abdomen only faintly annulated, rather uniformly light brown. Legs, wings, and tails colored as in male. Terminal abdominal sternites shown in fig. 8.

Nymph.—Length of body of mature specimens 8–11 mm. Dorsal view, fig. 1. Dorsum of abdomen almost unicolorous, but with a pair of slightly darker sub-median dots and a faint band at posterior margins of tergites. Sternites seven and eight each with a pair of round, subbasal spots, ninth sternite with a dark line at anterior and lateral margins. Gills relatively small for genus, and first and last pairs showing no tendency to converge beneath body.

Holotype, male.—Leonard Springs, near Bloomington, Indiana, April 25, 1946, W. E. Ricker et al. Specimen dry, on pin. *Allotype, female.*—Same data as for holotype. Specimen dry, on pin. *Paratypes.*—Indiana: Same data as for holotype, 10 ♂, 5 ♀ : 7 ♂, 4 ♀ dry, on pins; 3 ♂, 1 ♀ in alcohol; genitalia of 3 ♂ on microscope slides.

Nymphs.—Nymphal material of this species was collected at the following localities, all in Southern Indiana: Leonard Springs, near Bloomington, April 25, 1946, and March 14, 1945; May's Cave, near Bloomington, April 25, 1946; Speed Hollow, Springville, April 26, 1946. All nymphs collected near outlets of springs.

This species is most closely related to *Iron pleuralis* Banks, but differs in having the median spines of the penis lobes short and weak, rather than long and stout; the notch in the apical margin of each penis lobe is, also, shallower and narrower in *namatus* than in *pleuralis*. The apical margin of the forceps base in *pleuralis* is emarginate on the meson, but entire in *namatus*. From *fragilis* Morgan, *namatus* may be distinguished by its larger size and differently colored abdominal tergites.

Iron frisoni new species

Male.—Length of body 8 mm., of wing 9 mm. General color very light yellowish-tan, with thorax darker. A member of the *longimanus* group of species.

Head light yellowish, unmarked; ocelli black at bases; compound eyes contiguous on meson, grayish-brown, darker ventrad; antennae tan. Thorax uniformly light golden-brown, apices of meso- and metanota darker brown, lateral suture anterior to wing bases, and pleural suture ventral to wing bases, edged with a narrow, dark brown line; pronotum unmarked; foreleg light yellowish, femur with a dark brown mesal spot, narrow area at apex of tibia and apical tarsal segment slightly darkened; relative proportions of parts of foreleg: femur 23, tibia 34, first tarsal segment 11, second 12, third 10, fourth 8, fifth 4. Wings hyaline, veins C and Sc and humeral crossvein faintly brown tinted, other veins and crossveins colorless; costal crossveins in stigmatic area not slanting, nor anastomosed; stigmatic area of wing opaque, milky; costal crossveins wanting at base, weak and incomplete in mid-

region, well-marked in stigmatic area. Abdomen very light yellowish-tan, almost cream colored; tergites faintly brown tinted at posterior margins; sternites unmarked; apical abdominal tergites light tan; genitalia tan, penis lobes, fig. 4, with mesal hooks long, slender, and

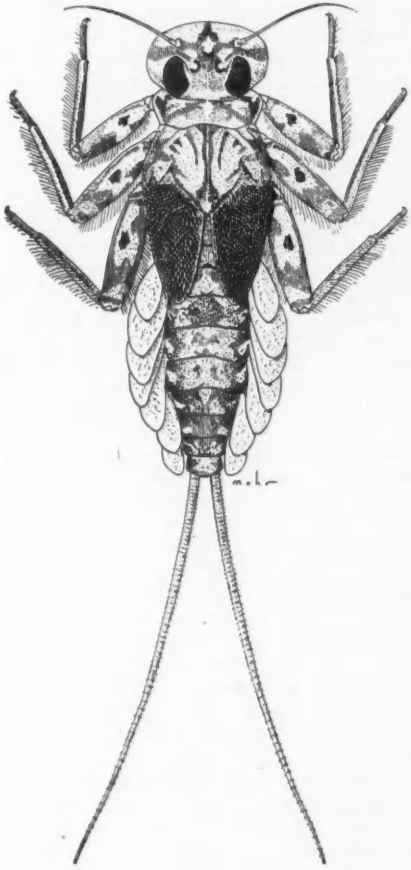


FIG. 1. *Iron namatus*, nymph, dorsal aspect.

with a deep apical notch, apical margin of forceps base dome-shaped, bluntly angled on meson.

Holotype, male.—Mt. Katahdin, Maine, Roaring Brooks, August 26, 1939, T. H. Frison. Specimen in alcohol; genitalia on microscope slide.

The fact that the first tarsal segment of the foreleg is slightly shorter than the second would seem to indicate that this species belongs in the genera *Cinygma* or *Cinygmula*. The type of genitalia, the lack of basal costal crossveins, and the fact that the stigmatic crossveins are not anastomosed, however, refer it to *Iron*. The structure of the genitalia in *frisoni* is closest to that of *longimanus* Eaton, but differs in that the median hooks are longer and more slender, and the penis lobes each have an apical notch; this notch is wanting in *longimanus*. The acutely angled projection on the inner, mesal margin of each of the penis lobes distinguishes this species, also, from *pleuralis* Banks or *fragilis* Morgan.

Genus **Heptagenia** Walsh

Heptagenia diabasia new species

Male.—Length of body 9–13 mm., of wing 8–12 mm. General color light yellow, with darker areas shaded with golden or light reddish-brown. A member of the *elegantula* group of species.

Head light yellowish, with a minute black dot at base of frontal shelf at either compound eye margin; vertex with a vague black spot on meson and diffuse reddish-brown shading just posterior to ocelli. Antennae yellowish; ocelli greenish-gray at bases. Compound eyes pearl gray, separated on meson by a space slightly less than width of median ocellus. Thorax yellowish or cream colored, shading to golden-brown on dorsal meson. Posterodorsal margin of pronotum and posterior margins of meso- and metanota shaded with dark brown; faint, light reddish-brown streaks at lateral margins of mesonotum, and on pleuron dorsal to meso- and metacoxae; meso- and metacoxal sutures, oblique pleural stripe anterior to metacoxa, minute spot on pleuron at base of forewing, and spot just dorsal to metacoxa, black or very dark brown. Foreleg yellowish, with reddish-brown shading on middle and at apex of femur, and at base of tibia; apex of tibia, and tarsal segments at articulations, dark brown; fifth tarsal segment entirely brown; relative proportions of parts of foreleg: femur 35, tibia 43, first tarsal segment 4, second 16, third 14, fourth 10, fifth 5. Wings hyaline, all veins and crossveins light brown; costal and subcostal crossveins slightly thickened, costal crossveins in stigmatic area slanted, occasional veins anastomosed; stigmatic area slightly milky, opaque. Middle and hindlegs yellowish, mesofemur reddish-brown at middle and at apex, metafemur reddish-brown at apex only; minute brown marks at articulations of tarsal segments, with fifth segment completely brown. Abdomen yellowish, posterior margin of each tergite with a narrow, transverse, black line. A black lateral, spiracular hair line extends full length of abdomen, with minute black hair lines extending from this longitudinal one to lateral margin at each spiracle. Apical tergites shaded with golden-brown on dorsum: eighth tergite completely shaded with golden-brown except for two short, yellowish, sub-mesal streaks at anterior margin, ninth tergite shaded on meson, yellowish laterally, and tenth tergite shaded at posterior margin. Occasional specimens have these color markings incomplete, but general pattern always visible. Abdominal sternites unmarked, uniformly pale yellow. Genitalia, fig. 7, tan, with delicate brown shading at margins of structures;

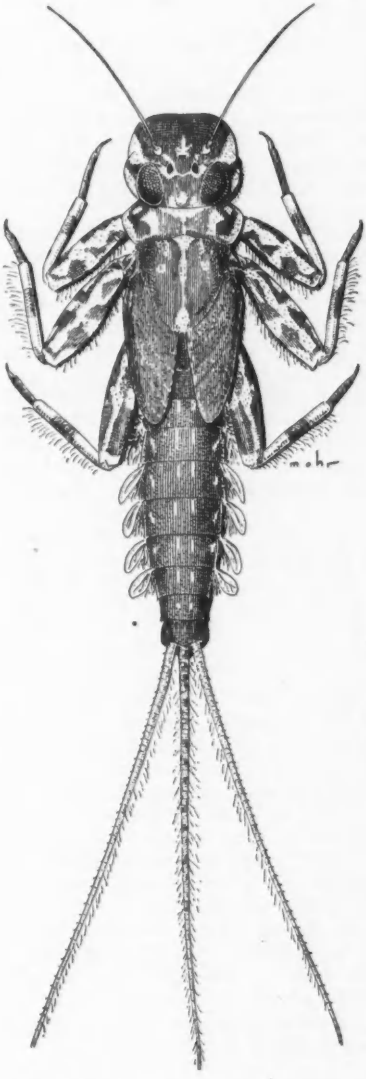


FIG. 2. *Heptagenia diabasia*, nymph, dorsal aspect.

apical margin of forceps base with a median notch; penis lobes with short median hooks and basal hooks which are stout at base. Tails white, joints brown.

Female.—Length of body 9–14 mm., of wing 10–15 mm. Ground color of body lighter than in male, almost white; thoracic notum only slightly darkened, not deeply shaded with golden brown as in male; lateral light reddish-brown thoracic streaks only faintly indicated. Black markings of head, thorax and abdomen same as in male. Apical abdominal tergites lacking dorsal golden-brown shading. Tails white, joints darkened with reddish-brown. Apex of subgenital plate, fig. 5, slightly indented on meson.

Nymph.—Length of body of mature specimens 8–15 mm. Dorsal color pattern as shown in fig. 2; dorsum of abdomen uniformly brown, with only minute dorsal and lateral light-colored markings. Abdominal sternites with a rather wide, longitudinal brown band near each lateral margin, mesal area light yellowish. Gills with dorsal plate relatively slender, subacute at apex; filamentous part conspicuous, projecting above dorsal plate, fig. 10.

Holotype, male.—Rockford, Illinois, June 29, 1938, at light, B. D. Burks. Specimen in alcohol; genitalia on microscope slide. *Allotype, female.*—Havana, Illinois, White Oak Creek, near Matanzas Lake, June 2, 1940, reared from nymph, B. D. Burks. Specimen in alcohol, with nymphal and subimaginal exuviae. *Paratypes.*—Illinois: Same data as for allotype, 4 ♂. Havana, June 1, 1933, at light, C. O. Mohr, 1 ♂. Homer, July 4, 1943, H. H. Ross, 1 ♂. Jerseyville, June 2, 1938, T. H. Frison, 1 ♂. Kankakee, Aug. 3, 1938, Burks & Boesel, 1 ♂. Kappa, June 22, 1943, H. H. Ross, 1 ♂. Mahomet, June 8, 1940, H. H. Ross, 1 ♂. Mazon, Mazon Creek, June 25–27, 1938, B. D. Burks, 3 ♂, 2 ♀, reared from nymphs. Milan, Rock River, June 4, 1940, Mohr & Burks, 5 ♂, 2 ♀, reared from nymphs. Momence, June 22, 1938, Ross & Burks, 1 ♂. Muncie, May 22, 1942, Ross & Burks, 1 ♂. Rockford, June 12, 1938, at light, Ross & Burks, 1 ♂. Iowa: Dennison, June 18, 1940, H. H. Ross, 1 ♂, 1 ♀. Red Oak, July 28, 1946, H. H. Ross, 1 ♂, 2 ♀.

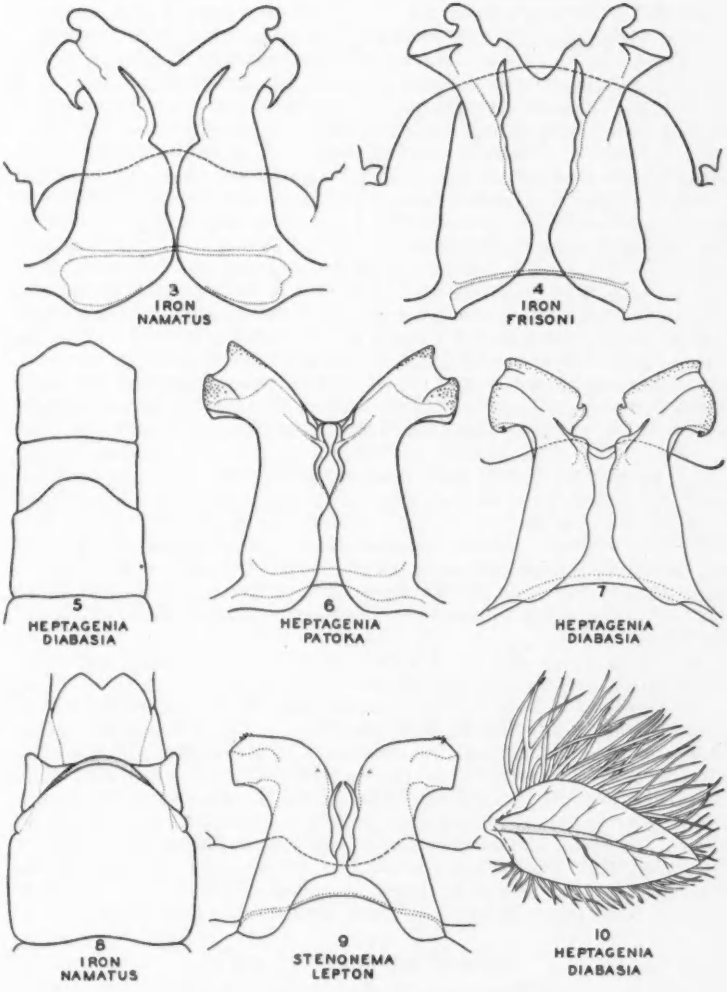
Twenty-two ♂ and 5 ♀ paratypes in alcohol; 1 ♂, 2 ♀ paratypes dry, on pins; male genitalia on microscope slide.

Nymphs.—Material, all from Illinois, was collected at the following localities: Havana, White Oak Creek, near Matanzas Lake, Nov. 5, 1939, and June 2–July 7, 1940; Mazon, Mazon Creek, June 24, 1938.

This species is most closely related to *H. elegantula* (Eaton), described from Colorado, but differs as follows: in the male genitalia of *elegantula* the median hooks of the penis lobes are long, whereas they are short in *diabasia*; also, the basal hooks are uniformly slender in *elegantula*, but are broad near the base in *diabasia*. The two also differ slightly in their color patterns, the head of *elegantula* having the pair of small black dots on the frontal shelf at compound eye margins, of *diabasia*, replaced by a pair of transverse, black stripes.

Heptagenia patoka new species

Male.—Length of body 9 mm., of wing 9 mm. General color tan, heavily marked with yellow-brown and red-brown. A member of the *flavescens* group of species.



FIGS. 3, 4. Male genitalia. FIG. 5. Female apical abdominal sternites. FIG. 9. Male genitalia. FIG. 10. Nymphal gill. FIGS. 6, 7. Male genitalia. FIG. 8. Female apical abdominal sternites.

Head uniformly tan, unmarked except for minute brown dot on meson of vertex between eyes; ocelli dark gray at bases; antennae tan, basal half of flagellum darkened, compound eyes gray shaded with tan, ventral portion darker; eyes separated on meson by a space as great as width of a lateral ocellus. Thorax brown on dorsum, shading to yellowish on pleura, apex of mesonotum and metanotum heavily shaded with brown; an oblique dark brown mark on mesopleuron ventral and anterior to wing base. Pronotum with minute dark brown mark on dorsal meson and at bases of forecoxae; foreleg light tan, a faint reddish-brown median mark and narrow subapical band on femur; tibia with a narrow brown area at apex; tarsal segments edged with brown at articulations, apical tarsal segment gray-brown; relative proportions of parts of foreleg: femur 24, tibia 28, first tarsal segment 3, second 9, third 8, fourth 5, fifth 4. Wings hyaline, light yellowish-tan in costal and subcostal interspaces of forewing; all veins and crossveins of forewing brown, anterior veins and crossveins of hindwing brown, posterior ones hyaline; crossveins in costal and subcostal interspaces of forewing broader and darker brown than others in this wing; humeral crossvein colorless at base, dark brown at Sc; small dark brown spot at bulla; stigmatic crossveins slightly slanted, not anastomosed. Abdomen brown on dorsum, light yellowish-tan on venter; tergites of first three abdominal segments with a pair of yellowish, submesal, rounded spots near anterior margin; following tergites with these spots more elongate, more vague, and considerably darkened, so as to be scarcely distinguishable from dark ground color; a faint, longitudinal, median, yellowish line present on five basal abdominal tergites. Sternites unmarked. Apical abdominal segments tan, genitalia tan, edged with brown, segments of forceps brown at articulations; tails tan, joints brown. Genitalia, fig. 6, with penis lobes relatively elongate and slender, and with median hooks short and slender.

Holotype, male.—Patoka, Illinois, July 19, 1945, Ross & Sanderson. Specimen in alcohol; genitalia on microscope slide.

This species is closely related to *flavescens* Walsh by genitalia, but differs markedly in color: in *flavescens* the abdomen is uniformly tan or brown on the dorsum, and the crossveins in the costal and subcostal interspaces of the forewing are not markedly broader and darker than the other crossveins in the wing; in *patoka* the dorsum of the abdomen is brown interrupted by conspicuous yellowish markings, and the crossveins of the costal and subcostal interspaces of the forewing are broader and darker than are the other crossveins in the wing. In genitalia the two differ in that the penis lobes of *patoka* are narrower and more elongate, with the median hooks much shorter and more slender.

Genus **Stenonema** Traver

Stenonema lepton new species

Male.—Length of body 7–9 mm., of wing 8–10 mm. General color very light yellowish, almost white, with thorax and apex of abdomen darker. A member of the *terminatum* group of species.

Head light yellowish or whitish with four small, irregular black spots at posterior margin of vertex: a small pair at compound eye margins

and a larger, submedian pair; base of antenna whitish, flagellum light tan; ocelli black at bases; compound eyes separated on meson by a space almost as wide as one compound eye. Thorax light tan, two minute brown spots on pleuron ventral to base of forewing. Pronotum unmarked; foreleg whitish, with dark red-brown band at middle and apex of femur and at apex of tibia; minute brown-shaded area at apex of each tarsal segment, claws gray-brown; relative proportions of parts of foreleg: femur 22, tibia 25, first tarsal segment 8, second 12, third 11, fourth 8, fifth 4. Wings hyaline, slightly milky in costal and subcostal interspaces, faintly red-stained and semi-opaque in stigmatic area; all crossveins in forewing brown, those in costal and subcostal interspaces slightly wider than others; veins C, Sc, and R_1 and R_2 brown, others hyaline; crossveins at bulla, in first three interspaces, arranged as 1-1-1 to 2-2-2 in all combinations: never more than two crossveins in an interspace in this area. All veins and crossveins of hindwing hyaline. Middle and hindlegs with rather faint, red-brown band in middle and at apex of femora, claws gray-brown. Abdomen whitish, a minute, dorsal black band at posterior margin of each tergite; spiracular markings wanting; sternites unmarked, apical abdominal tergites light tan, genitalia and forceps white, unmarked; tails white, joints not darkened. Penis lobes, fig. 9, angular, one pair of inner apical spines present, lateral spines wanting.

Holotype, male.—Momence, Illinois, June 22, 1938, Ross & Burks. Specimen in alcohol. *Paratypes.*—Illinois: Same data as for holotype, 5 ♂; same but June 24, 1939, Burks & Ayars, 23 ♂. Specimens in alcohol, genitalia of one male on microscope slide.

This species most closely resembles *S. terminatum* (Walsh), but has only one pair of penis spines (inner apical), rather than two pairs (inner apical and lateral) as does *terminatum*. The first segment of the foretarsus in *lepton* is two-thirds as long as the second, while in *terminatum* the first segment of the foretarsus is from one-third to slightly less than one-half as long as the second. From *bipunctatum* (McD.), *lepton* is readily separable by the color pattern of the abdominal tergites, as well as by minor differences in the male genitalia; *placitum* (Banks) has a different abdominal color pattern and slightly different male genitalia.

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A DESCRIPTION OF FORMICA PARCIPAPPA, A NEW ANT FROM IDAHO[1]

(Hymenoptera: Formicidae)

A. C. COLE, JR.,
University of Tennessee,
Knoxville, Tenn.

Formica parcipappa n. sp.

Holotype, worker. (Cole collection, No. 420.)

Total length, 5.8 mm.

Head, excluding mandibles, only slightly longer than broad, broadest between upper third of compound eyes, sides slightly convex, occipital angles somewhat rounded, median portion of occipital border only slightly concave. Median lobe of clypeus moderately and broadly convex when viewed laterally, projecting anteriorly rather abruptly from its lateral portions. Clypeal impression distinct, rather deep and angular. Clypeal carina feeble. Frontal area triangular, broader than long. Frontal lobes short, subparallel, acutely pointed anteriorly. Frontal furrow faint, extending about two-thirds the distance from frontal area to median ocellus. Compound eyes oval, convex, anterior border extending slightly in front of median portion of the side of the head. Mandibles 7-toothed, stout, very convex. Antennal scapes rather stout, gradually thickened from base to apex, slightly curved, distinctly surpassing posterior corners of the head by about one-fifth their length. Funicular segments longer than broad, segments 1–4 increase in breadth from base to apex, segments 5–10 cylindrical, slightly thicker than preceding segments, ultimate segment longer than penultimate, nearly as long as the combined lengths of the two preceding segments and tapering apically.

Pronotum rather strongly convex in profile, mesonotum somewhat less so. Promesonotal suture well marked and breaks the promesonotal outline in profile. Mesoepinotal suture narrowly and not particularly deeply impressed. Epinotum higher than long, the basal face straight and the obtuse angle between it and the abrupt slightly convex declivity sharp and only slightly rounded, the two faces of about equal lengths. Thorax, seen from above, stout; pronotum with very convex sides, less than twice as wide as the dorsum of the mesonotum; behind the mesoepinotal constriction, the lower portions of the mesonotum and epinotum are parallel. Petiolar scale, when viewed from in front, with the apex not greatly broader than the base; low, wide, thick at the base anterioposteriorly; as seen in profile, the anterior face consists of a short, vertical, basal portion which passes through a distinct angle to the long, nearly straight surface sloping posteriorly to the apex of the scale; the straight posterior face is feebly convex and only slightly slopes posteriorly to the base; superior border moderately sharp, broadly

[1]Contribution No. 13, Department of Zoology and Entomology, University of Tennessee, Knoxville.

rounded and feebly notched in the middle, when viewed from in front, and the corners are rather broadly rounded. Gaster moderately large, rounded.

Head, thorax and petiole finely and rather densely shagreened, subopaque, with a faint luster. Occiput, posterior corners, sides and venter of head, and the antennae and legs somewhat shining. Frontal area faintly shagreened and very shining in certain lights. Mandibles shining, coarsely and sparsely punctate, longitudinally, finely, rather irregularly and densely striate, the striae more pronounced toward the apex. Gaster uniformly shagreened, more shining than the thorax.

Erect hairs mostly pointed, yellowish, rather abundant, varying in length; most numerous on the gaster where they are scattered and longer on the posterior portion and the venter; on the head most abundant on clypeus, shorter on vertex, very sparse but long on gula, very short and sparse on occiput; a cluster of 20 long and shorter hairs on dorsal convexity of pronotum, eight much shorter ones on anterior portion of dorsum of mesonotum (just anterior to the mesoepinotal suture), a group of six moderately long ones on epinotum at posterior portion of epinotal base (near the angle of the epinotum), prominent along superior border of petiolar scale (and extending around the corners); long on coxae, shorter and less numerous on femora of fore legs and flexor surfaces of middle and hind femora. Pubescence fine, indistinct, rather short and everywhere sparse; most prevalent on antennae, anterior surface of petiolar scale and on the gaster (where it is somewhat longer and denser but does not obscure the shagreened surface.)

Light ferruginous, head slightly darker, antennae somewhat darker than the head, mandibles rich reddish brown, superior border of petiolar scale dark reddish brown. Posterior borders of first three gastric segments each with a broad, somewhat irregular transverse light brown band which is darker than the rest of the gastric segment and which narrows laterally and widens greatly ventrally; median portion of first gastric segment slightly suffused with brown.

Variation in Paratype Series.—Total body length varies from 4.9 to 5.8 mm. In some specimens the frontal area is nearly equiangular, and in none is it longer than broad. In the smaller workers the color of the body is somewhat darker, and there are distinct splotches of brown on various parts of the head (notably the vertex and genae) and the pronotum and mesonotum; in a few of the paratypes the increase in breadth of antennal funicular segments includes segments 5 and 6, although decreasingly so; in some specimens the petiolar scale, when viewed from in front, has more diverging sides than that of the holotype (and hence is proportionately broader at the apex than at the base), the superior border is less broadly rounded and its corners are more sharp; the thoracic hairs are more delicate; the occipital border is straight and the sides of the head are more convex. In some specimens, irrespective of their size, the clypeal notch is deeper and more distinct than in others; in no specimen is it indistinct. The length of the frontal furrow varies greatly, but on the average it does not extend more than one-half the distance from the frontal area to the median ocellus. Two specimens lack hairs on the gula, the others possess one or two rather long gular

hairs; two specimens have only one or two distinct occipital hairs; one specimen bears a few short hairs on the occiput, the posterior corners of the head, the genae and the sides of the head behind the eyes. One large worker has the genae, thorax, petiolar scale and gaster flecked with brown. The gaster of one of the paratypes is not at all banded with brown, and the gaster of a few others is only very slightly banded. In one worker of medium size, the gaster is more densely pubescent.

Type Locality.—Near Nampa, Idaho. The holotype and the fifteen paratype workers were collected by the writer, July 11, 1931. The workers were foraging on the ground in a community of greasewood and shadscale. The nest was not found. The slave is unknown.

Affinities.—The clypeal notch identifies this species as a member of the Sanguinea Group. At the first appearance of ***paricipappa***, one is reminded of ***bradleyi***, because of the similarity in coloration. The two species have little in common, however. The new species is of considerably greater size, the head has a different shape, the clypeal carina is much more feeble, the clypeal notch is very much deeper and less broad, the petiolar scale is broader and has a sharper superior border, the epinotum is more angular, the pilosity is much less abundant and less evenly distributed, and the body is less shining.

The new species appears to be most closely related to ***wheeleri***, which it resembles structurally rather closely, but from which it differs by such characters as follows: the shape of the head is somewhat different; the basal and declivous faces of the epinotum are of about equal length, and the angle formed by the two surfaces is much sharper and less broadly rounded in profile; the pronotum is more convex; the promesonotal impression breaks the promesonotal outline; the petiolar scale is proportionately somewhat broader at the base, and the corners of the superior border are more rounded; the genae lack coarse and shallow punctures; the lobe of the clypeus lacks striae; the pubescence is more dilute; the body surface has more of a luster; and the color is different.

The writer is indebted to Dr. W. S. Creighton, who kindly compared specimens of the new species with types of ***emeryi*** and ***pergandei***. Paratypes are to be deposited in the U. S. National Museum and in the collection of the writer.

THE TABANIDAE OR HORSEFLIES AND DEERFLIES OF GEORGIA, by P. W. FATTIG. Emory University Museum Bulletin, No. 4, pp. 25, 1946.

This pamphlet is a companion to Dr. Fattig's Asilidae of Georgia, reviewed last year, and follows the same plan of treatment. The first few pages are devoted to acknowledgments and brief statements on economic importance and life history. A page is occupied by some notes on parasites and predators which attack these flies. The author's comments on collecting tabanids are interesting. The major part of the bulletin includes a list of one hundred and eighteen species with data on distribution but no other material. A bibliography of thirty-four titles concludes the work.—A. W. L.

LARVAL DETERMINATION OF SIX ECONOMIC SPECIES OF LIMONIUS

(Coleoptera: Elateridae)[1]

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Bureau of Entomology and Plant Quarantine,
United States Department of Agriculture

Wireworms are primary insect pests of crops in the irrigated lands of the Pacific Northwest, and more locally throughout the United States. Those of importance to agriculture throughout this country represent perhaps three-score species, distributed among several genera. In the Pacific Northwest the most important species belong to the genus *Limonius*, and the major part of the control work has been done on these species. The Pacific Coast wireworm (*Limonius canus* Lec.) and the sugar-beet wireworm (*L. californicus* Mann.) are generally distributed throughout both the irrigated and the naturally moist areas of the semiarid portions of the United States west of the Rocky Mountains. The western field wireworm (*L. infuscatus* Mots.) and the Columbia Basin wireworm (*L. subauratus* Lec.) are not so generally distributed, but are of economic importance in limited areas, and are frequently associated with *L. canus* and *L. californicus*. Observations, field studies, and laboratory experiments show that the larvae and the adults of these species show specific differences in their response to field conditions and treatments.

In the Eastern United States[2] the eastern field wireworm (*L. agonus* (Say)) and *L.* (*Nothodes*) *dubitans* Lec. are of economic importance in certain areas and under certain conditions. Two other species that are probably of economic importance are *L. ectypus* (Say) and *L. anceps* Lec.

The close relationship of the four eastern species to the four western species, as shown by the adults and by the larval stages so far as they are known, make it probable that their activities and responses in the field are similar. In this study on larval determination it seems advisable to include *agonus* and *dubitans* with the four western species. Accurately determined larvae of *ectypus* and *anceps* are not available for study. This group of closely related species is part of what might be considered a subgenus.

For several reasons larval determination is more important in the study of wireworms in general, or of any group of wireworms in particular, than it is in the case of most insects. The life cycle in most species ranges from 2 to 6 or more years. The flight activity of the beetle makes it impossible to determine either the field from which it first emerged or that in which it may have oviposited. Moreover, the

[1]This work was done at Walla Walla, Washington, as a part of wireworm investigations conducted in the Pacific Northwest under the direction of Merton C. Lane.

[2]In this paper Eastern United States refers to the region east of the 105th meridian, Western United States to the region west of this point.

beetle stage does not exist during part of the season. Any change in species dominance due to change in farm practice is not indicated by adult populations for approximately 3 years. The months, and usually years, required to rear to adults an adequate sample of the wireworms

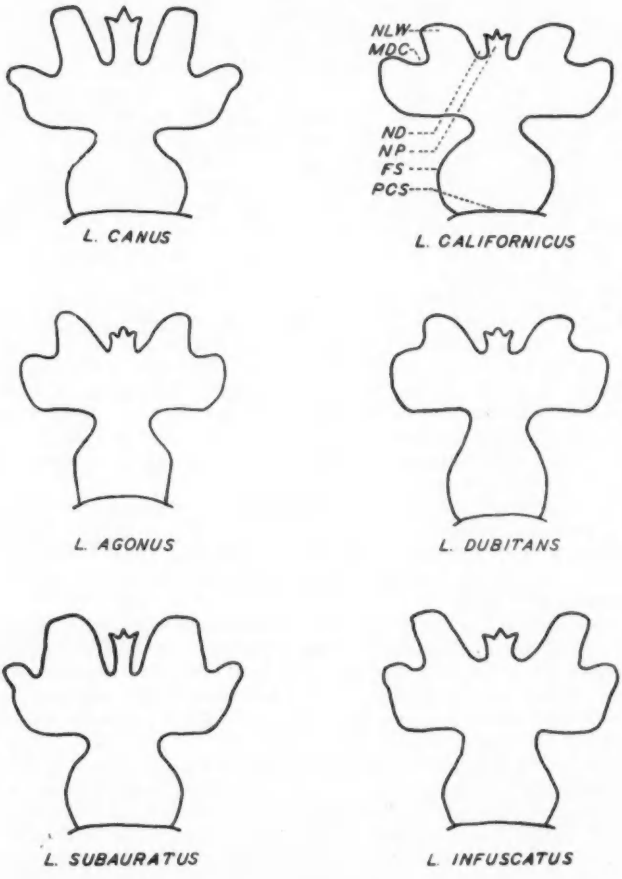


FIG. 1. Portion of dorsal surface of head capsule: *FS*, frontal suture; *PCS*, post-occipital suture; *MDC*, dorsal condyle of mandible; *NP*, nasal projection; *NLW*, lateral wings of nasals; *ND*, nasal depression.

used in an experiment, or found in a field, makes rearing impractical even if the process itself frequently does not provide difficulties. This long period of larval development, together with the fact that all the

immature stages and most of the adult life are spent in the soil, makes essential a means of recognizing the species in the larval stage.

The recognition of this need for the classification of elaterid larvae is not new. Until recently most of the work on these larvae has been done in Europe on species of *Agriotes*. Most of the early investigators dealt with field-collected larvae, and their results contain several serious errors in determination. Few of the pioneer workers were acquainted with the changes that occur to the individual larvae, especially those due

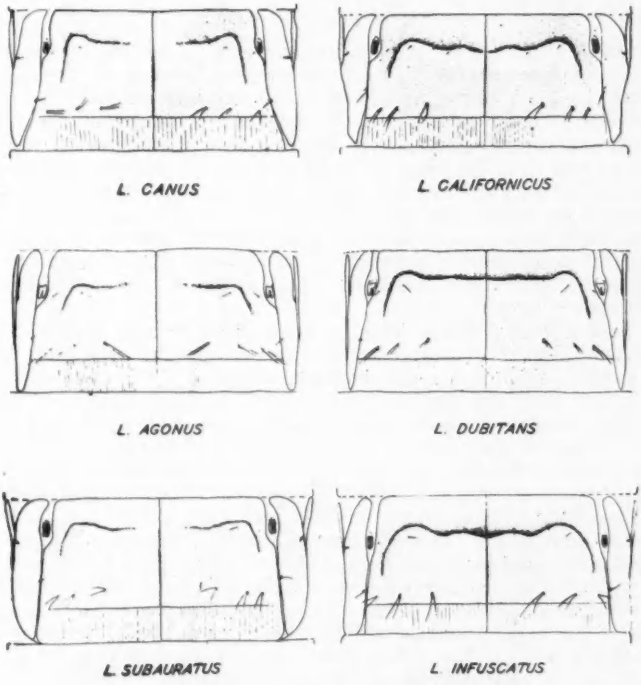


FIG. 2. Dorsal surface of third abdominal segment.

to wear during the period between molts. The size, form, and length of the mandibles and the nasal projection were therefore used as primary characters by such outstanding authorities as Schiodte (6) and Henriksen (3). Horst (4) recognized that the nasale was subject to extreme wear, but did not mention that the mandibles may lose much of their length and all the acuteness of their tips as a result of wear during the period between molts. Furthermore, Horst did not call attention to the complete renewal of both nasal projection and mandible, which is normal in each instar, but wrote rather confusingly of the worn condition of these structures in the older stages of the larvae.

The following descriptions and key to the larvae of six species of *Limonius* should provide a means for separating these larvae. The notes and illustrations included in this paper are only those parts of the morphological studies which are expected to be of direct assistance in the understanding of the key. The terminology is that used by the author (5) in a detailed description of the external anatomy of the larva of *canus*. The resulting determination of species should make possible greater accuracy both in experiments and in recommendations for control.

DESCRIPTION OF LARVA

Limonius larvae are to be recognized among elaterid larvae by the largely sclerotized body covering, with visible membranous areas in the pleural regions; by the ninth abdominal segment with a pair of well-separated terminal urogomphi, the horizontal branches of which bend mesally to enclose a cavity, or keyhole, but without other armature such as horns on the tergal plate or scansorial hooks on the surface of the anal projection; and by the subquadrangular postlabium which separates the stipites throughout their length. The mandibles of these larvae each have a proximal tooth or lobe as well as a distal one. The nasal projection has three distinct and nearly equal teeth, and the urogomphi have distinct vertical branches. There is no evidence of eyespots or ocelli.

Head Capsule.—In general form the head capsule of the various species is similar throughout. The frontal sutures (FS) (fig. 1) are the most apparent features of the dorsal surface. These arise, somewhat separated, from the postoccipital suture (PCS) or base of the head capsule, diverge anteriorly to approach again near the center of the dorsal surface of the head, and then suddenly separate to pass around the dorsal condyles of the mandibles (MDC), and close by the bases of the antennae. Measurements taken at points on these sutures illustrate that the head capsule of the larva of *californicus* is both broader and blunter than in the other species. Thus in this species the distance between the sutures at the point of medial constriction is only one-fifth of that between the anterior ends outside the mandibular condyles; in the other species it is one-fourth. In *californicus* the distance from the base of the nasal projection (*NP*) to the median constriction is only two-thirds of that from the constriction to the bases of the frontal sutures on the postoccipital suture, and in the other western species the two lengths are equal. In the two eastern species the first distance is slightly less than the second.

Tergites of First Eight Abdominal Segments.—The tergites, or dorsal sclerites, of the first eight abdominal segments are mainly characterized by the anterolateral, or anteromarginal, grooves. These grooves, which parallel much of the anterior and lateral margins of each of these tergites, appear to be superficial sculpturings on the terga. They are, however, uniform in length and in intensity within the species, and are developed to their greatest extent on the terga of the second, third (fig. 2), and fourth abdominal segments. In *infuscatus* larvae the groove is strongly marked by the heavy sclerotization on its anterior and lateral margins. The grooves usually extend to the median suture and join without any

evidence of a break. Occasionally they end short of the median suture, but always near it and very abruptly. In *californicus* and *dubitans* the demarcation of the groove is strong. The termination of the anterior portion of the groove is at or near the median suture and is very abrupt. In these two species, however, the grooves are seldom connected across

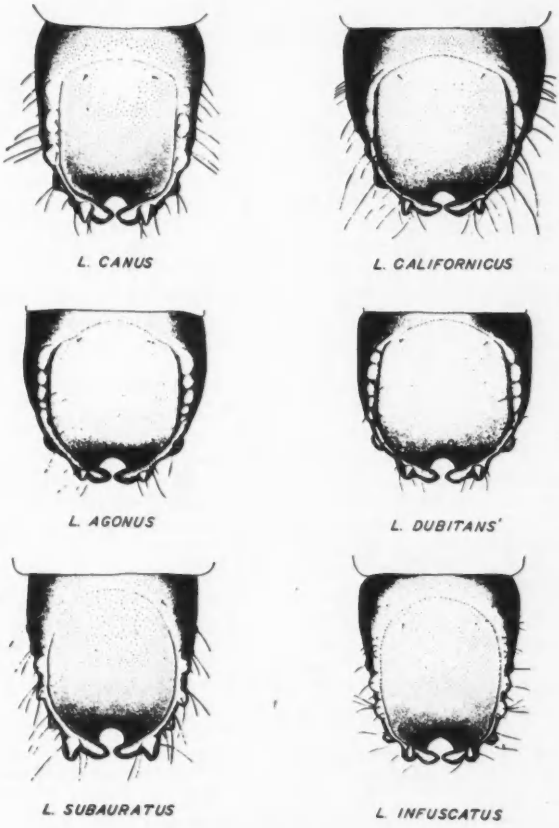


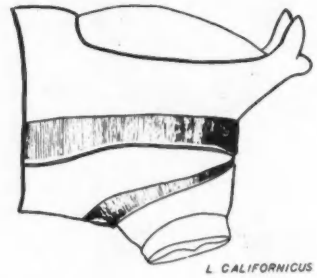
FIG. 3. Dorsal surface of ninth abdominal segment.

the median suture. In *canus* and *agonus* the anterior and lateral margins of the grooves are less strong and the anterior portion of the groove gradually fades out mesally, ending, sometimes after one or more breaks, a short distance from the median suture. In *subauratus* the condition is similar to that of *canus* but even less distinctly marked,

and the anterior portion of the groove fades out some distance from the median suture.

Hawkins (2, p. 64) illustrates and briefly described a *Limonius* larva, but overstresses the size of the setae of the anterior portion of the abdominal segment, and fails to realize the value of the anterolateral grooves in this group.

The Ninth Tergite.—In each of these larvae the dorsal plate of the ninth abdominal segment (fig. 3) is more highly specialized than are the similar plates of the preceding segments. The anterolateral groove



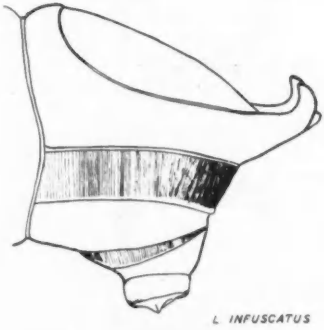
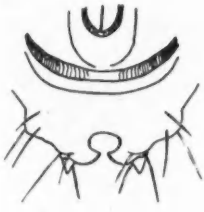


FIG. 4. Lateral view of ninth and tenth abdominal segments.



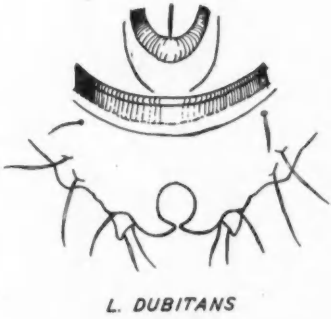


FIG. 5. Ventral view of keyhole of last abdominal segment.

outlines a large, nearly smooth tergal plate which is gradually elevated to the middle, but without the median suture. The lateral margins of the grooves become more elevated and rugose as they extend posteriorly and terminate in paired urogomphi, each of which is branched. The tergal plate is rounded anteriorly, nearly straight laterally, and posteriorly depressed and extending between the urogomphi to the keyhole opening. In *canus* and *infuscatus* the plate is longer than wide, in *californicus* and *subauratus* wider than long, and in *agonus* and *dubitans* approximately as wide as long. The gradually increasing height of the

lateral elevations and of the urogomphal structure makes the plate appear to be longer than it is and to narrow distally more than it does. In *subauratus* the tergal plate is more rounded and, like *infuscatus*, is flatter than the other species; even the eastern species have more angulate corners.

The elevations, or warts, on the lateral margins of *canus* and *californicus* are elongate, beadlike oval masses. On *infuscatus* these warts are more concave on the inner surface and tend slightly toward the almost earlike scallops found on the margins of the tergal plate in certain other genera, for example, *Drasterius* and *Hypnoidus*. These concavities are for the reception of single spines. In *subauratus* this condition is somewhat intermediate between *canus* and *infuscatus* but approaches *infuscatus*. *Limonius agonus* and *L. dubitans* closely resemble *canus* in this respect, with the lateral margin perhaps less elevated and less rugose. In *californicus* and *infuscatus* these warts are more rugged, and usually more numerous, than in the other associated species.

The parts of the paired urogomphi may be termed the "vertical" and the "horizontal" branches. The vertical branch of each urogomphus is the smaller of the two branches, and may appear as little more than a conelike enlargement of the warts in the lateral margin of the tergal plate. Although in most of these species the vertical branches arise nearly perpendicular to the plane of the larval body, in *infuscatus* the original direction is slightly posterior and as it arises the branch is gradually bent anteriorly. The result is a uniformly bent, anteriorly directed sharp hook (fig. 4). The vertical branches in the other species are tapered and erect, although the slant is likely to be steeper on the anterior and mesal faces, as in *californicus* (fig. 4). In *subauratus* certain specimens may have this steepness so pronounced as to give a first impression of being slightly hooked. The distance between the tips of the vertical branches is of taxonomic value. In *canus*, *infuscatus*, and *agonus* this distance is approximately twice the length of the transverse axis of the keyhole. In *californicus* and *subauratus* the distance is about three times this measurement of the keyhole, and in *dubitans* the condition appears to be intermediate, the distance between the tips being approximately two and one-half times the length of the transverse axis of the keyhole.

KEY TO THE LARVAE OF SIX ECONOMIC SPECIES OF LIMONIUS

1. Inner ends of anterolateral grooves of second, third, and fourth abdominal tergites remain strong as they approach the median suture..... 2
   Inner ends of anterolateral grooves of second, third, and fourth abdominal tergites fade and end before reaching the median suture..... 4
2. Vertical urogomphi curved anteriorly to form hooks; ninth tergal plate flattened, its elevated lateral margin with concave scallops, its anterior angles rounded. Western United States..... **infuscatus**
   Vertical urogomphi not recurved to form hooks; ninth tergal plate convex, its elevated lateral margins with wartlike swellings, its anterior angles angulate..... 3
3. Distance between ends of frontal sutures outside of mandibular condyles five times that between these sutures at point of medial constriction. Western United States..... **californicus**
   Distance between ends of frontal sutures outside of mandibular condyles four times that between these sutures at point of medial constriction. Eastern United States..... **dubitans**

4. Width of urogomphal keyhole approximately one-half distance between tips of vertical branches of urogomphi; ninth tergal plate convex, its elevated lateral margins with beadlike swellings, its anterior angles angulate..... 5
Width of urogomphal keyhole approximately one-third distance between tips of vertical branches of urogomphi; ninth tergal plate flattened, its elevated lateral margins with concave scallops, its anterior angles rounded. Western United States.....**subauratus**
5. Ninth tergal plate rounded, only slightly angulate. Eastern United States.....**agonus**
Ninth tergal plate elongate, distinctly angulate. Western United States, **canus**

The larvae of ***infuscatus*** are readily distinguished from those of the other species, as they have the tips of the vertical urogomphi curved anteriorly to form hooks (fig. 4). The larvae of ***canus***, ***dubitans***, and ***agonus*** are recognized by the direction of the origomphal keyhole. In these species it forms an angle of about 45° with the plane of the body, pointing posteriorly as much as downward. In the other species the angle formed is nearly 90° or almost vertical. The larvae of ***californicus*** are unique in that the distance between the frontal sutures where they are bent inward is only one-fifth that between the bases of the antennae, as compared with a distance of one-fourth (fig. 1) in the other species. The larvae of ***subauratus*** are separated from those of ***infuscatus*** by the more nearly circular tergal plate, circular keyhole, and straight tips of the vertical branches of the urogomphi, as well as by the briefer, fainter inner ends of the anterolateral grooves. The two eastern species are also readily distinguished by the shape of the keyhole as viewed from beneath (fig. 5). In ***dubitans*** it is circular and in ***agonus*** irregularly ovoid.

Glen *et al.* (1) divide the ***Limonius*** larvae into two groups. All six of the species included in this study belong in their group 2 and would be under caption 33 of their key.

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A REVISION OF THE GENUS LACHESILLA NORTH OF MEXICO[1]

(Corrodentia: Caeciliidae)

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Urbana, Illinois

The family Caeciliidae (according to Chapman's classification, but with the addition of more recent records) contains at least thirty-nine previously described Nearctic species. The genus *Lachesilla* is one of nine genera in the family Caeciliidae and contains ten previously described species for this region. This study treats twenty-four species, twelve that are new to science, one that is here transferred to this genus, one that was previously considered a variety and is here elevated to species rank, and the ten species previously placed in *Lachesilla*.

In so far as I have been able to determine eleven species in this genus have been described from Europe, Mexico, Central and South America. Very likely many more species occur in this genus, some of which have already been described under *Caecilius* or closely related genera, besides others yet to be described. Corrodentia as a whole have not been intensively collected throughout this country. Judging from the material examined, the Lachesillas have been neglected too. Most of the more intensive collecting has been done around Ithaca, New York; Urbana, Illinois, and Mt. Carmel, Connecticut.

In general the species of *Lachesilla* are found out-of-doors breeding in dried leaves hanging in bunches on trees, dried grass in the fields, dried cornstalks, on branches and twigs of conifers and in ground-cover. The individuals are usually found on the inside of the curled, dried leaves or in other protected situations. Some species breed indoors under favorable conditions in mouldy organic materials such as: cereals, straw, papers and wood.

Not much is known concerning the bionomics of the species in this genus, but the few I have reared or observed, namely: *nubilis*, *pedicularia* and *contraforcepeta*, deposit their eggs singly and do not cover them with conspicuous silk mats. The eggs are oblong-oval, especially after development is well under way, with a spoon-shaped groove on top, fig. 46. One species at least, *contraforcepeta*, deposits flat, oval eggs that thicken as development proceeds. From information based on *pedicularia* and *nubilis* the egg stage lasts about one week, the six nymphal stadia cover a period of two or three weeks, and the adults live about two weeks. Figs. 46, 48, 47, and 49 are egg, fifth instar nymph, adult female and a male of *Lachesilla nubilis* (Aaron) respectively, a widely distributed species typical of the genus. In this region the species apparently overwinter mainly in the egg stage. It is interesting

[1]Contribution No. 269 from the Entomological Laboratories of the University of Illinois. Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Entomology in the Graduate School of the University of Illinois, 1945.

to note that the fall eggs of *contraforcepeta*, unlike the other two species, do not hatch until subjected to a period of cold. Males are known for all but three of the twenty-four species concerned in this paper. Although it is possible, it should not be inferred that these three species are parthenogenetic because few collections of these three species are at hand, and the males have probably not yet been taken. The silk produced by the nymphs and adults is inconspicuous. The nymphs and adults feed on fungus growths and organic material. In this region they are most abundant in the late spring and fall of the year.

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The following institutions loaned for study their material in the genus *Lachesilla:* Illinois Natural History Survey, United States National Museum, Pennsylvania State College, North Carolina State College, Massachusetts State College, Ohio State University, University of Kentucky, Cornell University, Chicago Natural History Museum, Michigan State College, University of Minnesota, Dominion Entomological Laboratory at Saskatoon, University of Kansas, Kansas State College, South Dakota State College, North Dakota State College, State College of Washington, University of British Columbia and University of California at Berkeley. I wish to thank the Curators, or those in charge of the collections, at these institutions for the use of their material, for without it this study could not have been made.

COLLECTION, PRESERVATION, PREPARATION

The equipment used in collecting is all relatively simple and is easily obtained. The necessary articles are: sweeping net, aspirator, pipette, forceps, sifter and white cloth, vials and 80% Ethyl alcohol.

After beating or sweeping conifers, dried vegetation, shaking bunches of dried leaves in the net, etc., one can gradually open the net and pick up the psocids with an aspirator, because they are rather sluggish and do not fly readily. When sifting ground-cover a cloth bag with a quarter-inch wire mesh bottom works well. Several handfuls of ground-cover, such as dead leaves, twigs, dry grass, etc., are put into the sifter and shaken several times over a white cloth. The psocids can be picked up quickly from the sheet with an aspirator. Sometimes curled, dried leaves or corn sheaths opened by hand reveal whole groups of *Lachesilla* adults, nymphs and eggs. If the vial type of aspirator is used the psocids can be killed, after shaking them to the bottom, by quickly pouring in one or two cc. of alcohol. Then the specimens can be transferred to a vial by pouring, by means of a pipette, or the larger ones can be handled with forceps. A penciled field label should be dropped into the vial.

Material of *Lachesilla* as with other Corrodentia in general, is best preserved in 80% Ethyl alcohol. Homeopathic rubber-stoppered vials are most satisfactory for storage because there is very little evaporation over a long period of time, and the vials, if kept in racks, are easily manipulated. It is best to put the specimens in a small shell vial 25–35 mm. long and plug the opening with cotton while it is submerged in the Homeopathic vial of alcohol thus eliminating the possibility of an air bubble in the shell vial. Then the shell vial with its contents is removed, inverted, and dropped back into the lip vial, cotton-end down. The collection data, including locality, date, habitat or host, and collector are printed in ink (Higgins Eternal Black) on a small label and put in the lip vial along with the identification label, both with printed side out. This little inner tube, or shell vial as it has been called, prevents the psocids from becoming battered or chopped up by the movement of the labels in the alcohol. It is well worth the added time and expense.

Pinned specimens or pointed material are very unsatisfactory and have to be removed from the pin, cleared and studied in alcohol. In some cases of borrowed pinned material, the whole specimen was soaked from the pin or point and prepared for study. After determination it was put in a tiny 10x4 mm. vial with a little glycerin in the bottom. Care should be taken to make sure that the KOH is entirely removed from the specimen and that the opening of the vial is dry. This prevents the cork from turning black and disintegrating. Then a pin was put through the cork and the whole treated as a pinned specimen.

Slide mounts *in toto* are still more *unsatisfactory* because they require more time to prepare and then the specimen can not be manipulated and the necessary characters can not be seen.

The abdomen is cut off under the microscope with a small scalpel or razor chip. I have found a scratch-pen very useful for this purpose. It

is then left in 2–5% KOH for 8–12 hours (usually over night) at room temperature. Then it is removed and placed in distilled water and the contents squeezed out. One can eliminate this squeezing process if the abdomen is cut off about one-third of the way from the thorax for then the contents do not rupture the abdomen upon swelling when placed in distilled water. The terminalia can be studied in this condition and many of the species determined without staining, if one is careful to manipulate the light. In staining I have submerged the abdomen in a drop of Mercurochrome on a slide and left it for several minutes. Then if it is removed and rinsed a bit in 70% alcohol the opaque red disappears and leaves a delicate pink specimen. This can be studied in alcohol in a Syracuse dish, and held in place by means of a small gob of Petroleum jelly on the bottom of the dish. The specimen can be cleaned of grease by rinsing in Carbon Tetrachloride and transferring to alcohol. Sometimes it is necessary to put the specimen in a "Well" slide in glycerin and study it under the high power of a regular compound microscope. In most cases I have returned the terminalia or terminalia parts to alcohol and put them in 10x4 mm. vials, placed in the Homeopathic vials, but outside the inner tube.

DISPOSITION OF TYPE MATERIAL

Holotypes, allotypes and paratypes have been deposited in the collections of the following individuals or institutions: Chicago Natural History Museum (CNHM), Canadian National Museum (CNM), Cornell University (CU), Dominion Entomological Laboratory at Saskatoon (DELSS), Illinois Natural History Survey (INHS), Kathryn M. Sommerman (KMS), University of Kansas (KU), Museum of Comparative Zoology at Harvard University (MCZ), Philadelphia Academy of Natural Sciences (PANS), Paul J. Chapman (PJC), University of California at Berkeley (UCB) and the United States National Museum (USNM). The institutions are referred to by the above abbreviations, which in the text, follow the locality records.

CLASSIFICATION

Genus **Lachesilla** Westwood

Lachesilla Westwood (1840, p. 47). Genotype, monobasic; *Termes fatidicum* L. (See Gurney, 1939.)

Terracaecilius Chapman (1930, p. 343). Genotype by original designation: *T. pallidus* Chap. New Synonymy.

This genus includes small apterous to macropterous psocids with 13-segmented antennae and 2-segmented tarsi. The wings are in most species well developed with Cu_{1a} and Cu_{1b} present in the forewings and Cu_{1a} not joined to M. There are no conspicuous hairs present on the wing margin, veins or in the cells (fig. 45). Chapman (1930) includes keys to the families and genera of the Isotecnomera accompanied by general discussions for each category, therefore such information is not repeated here.

Until Chapman's paper appeared the majority of the descriptions of psocids from this country dealt mainly with the gross or superficial

characters such as general color, color-pattern, size and wing venation. As specific characters these are relatively consistent, but often the degree of difference between species is so slight that positive determination can not be made when using these characters alone. In reference to characters of wing venation there is one species possessing subapterous forms, others with brachypterous or subapterous females and macropterous males; so it is evident that difficulties would be encountered in these particular cases. Also, there are often anomalies in wing venation and when such peculiarities occur on both wings of a specimen characters of venation are misleading. When color is used there is always the difficulty of determining newly emerged adults that have not yet obtained their normal coloration. Characters of wing venation are usually not specific characters, but are of generic value.

In this genus excellent morphological characters of specific value are to be found in the terminalia of both sexes. Some comprehensive studies have been published on the morphology of the Corrodentia (Badonnel 1934, Cope 1940) but the conclusions reached by the various workers do not entirely agree. This is probably because of the fact that each has limited his study to one particular species. I am of the opinion that a morphological study of several members of each genus in the order would result in definite and well-founded conclusions as to the homologies of the various structures. Therefore I believe it is not wise at this stage to coin new terms for specific parts or to try to apply to certain structures any more of the accepted specific terms used in other groups of insects. To avoid unnecessary change I have therefore followed Chapman's terminology which is very general and I have used labeled illustrations to indicate the actual structures referred to. The abbreviations used on the plates are given in parentheses after each term in the following list.

STRUCTURES COMMON TO BOTH SEXES

Sense tubercles (ST).—The conspicuous lateral or lateroventral tubercles posteriorly on the terminalia. The tubercles are covered with setae, each of which is inserted in a circle of membrane. These tubercles are present in all species and are very conspicuous in all excepting *pallida* females; therefore they are here used for purposes of orientation.

Paraprocts.—The lobes bearing the sense tubercles, laterad of the anus.

Suranal plate (SAP).—The terminal dorsal lobe posterior of the sense tubercles.

STRUCTURES OF MALES

Prongs of paraprocts (PR).—Sclerotized prongs, when present, on the ventral, mesal, usually distal region of the paraprocts.

Parameres (PAR).—The ventral, long slender, paired, mesal structures, internal, at least basally, and usually fused at the base to form a Y-shaped structure.

Claspers (CL).—The long paired, ventral, external structures anterior and mesad of the sense tubercles.

Hypandrium (HYP).—The pigmented region lying ventrally between the sclerites bearing the claspers.

Groove clasp (GC).—Sclerites overlapping the claspers about midway in *punctata*.

Lateral hooks (LH).—Lateral projections of the suranal plate.

STRUCTURES OF FEMALES

Gonopophyses (GON).—The ventral, paired, flat, external, thumb-like projections antero-mesad of the sense tubercles.

Subgenital plate (SGP).—The broad external, ventral plate anterior of the exterior genital opening.

Ventral interior plate (VIP).—The sclerotized and sometimes pigmented internal plate which forms the ventral surface of the egg passage. In several species this plate has apparently become fused externally to the posterior margin of the subgenital plate.

Dorsal interior plate (DIP).—The sclerotized and sometimes pigmented, internal (for the most part) plate which forms the dorsal surface of the egg passage, and lies mesad between the bases of the gonapophyses.

Lateral projections (LP).—When present, the distal, lateral projections of the subgenital plate.

Flap (F).—The external, median distal process of the subgenital plate, present in some species.

KEY TO SPECIES

Terminalia ventrally possessing long, slender, mesal structures, internal, at least basally (parameres), figs. 1–18, 41–43 ..... males

Terminalia ventrally possessing plate-like mesal structures, if long and slender, then external, figs. 19–40, 44 ..... females

MALES

1. Parameres fused basally, forming a single median shaft 2
   Parameres independent, or at least not forming a single median shaft 18
2. Paraprocts bearing sclerotized prongs mesally 3
   Paraprocts fleshy and lobe-like mesally, no prongs 13
3. Distal margin of suranal plate bilobed, fig. 12; or produced into two lateral processes, figs. 6, 14, 16, 18, 41; or bilobed with two small median hooks, almost completely fused, fig. 5 4
   Distal margin of suranal plate not lobed but evenly rounded, fig. 13; or produced into a single median process, figs. 9, 15, 17 10
4. Lateral hooks of suranal plate twisted, asymmetrical; claspers fused to form a single median asymmetrical process, fig. 6 ..... **silvicola**
   Terminalia symmetrical 5
5. Two pairs of long slender, external processes (claspers), with bases side by side, present ventrally, figs. 5, 12 6
   Only one pair of long slender, external processes (claspers) present 7
6. Central shaft of parameres one and one-half times length of longer laterad clasper-like process, fig. 5 ..... **riegeli**
   Central shaft of parameres about one-half length of laterad clasper-like process, fig. 12 ..... **corona**
7. Prongs of paraprocts strongly sclerotized and flared distally; suranal plate produced into two knobs (dorsal and ventral) laterally, fig. 16 ..... **dona**
   Prongs of paraprocts short, not modified; suranal plate with single lateral lobes, figs. 14, 18, 41 8
8. Hypandrium produced posteriorly into acute median projection; prongs of paraprocts projecting mesally, fig. 41 ..... **penta**
   Hypandrium transverse or small and rounded posteriorly; prongs of paraprocts directed posteriorly, figs. 14, 18 9
9. Claspers long, double-curved, flat blades; their length about three times the distance between their bases; parameres protrude externally about half way up length of claspers, fig. 18 ..... **nubilis**
   Claspers simple, curved; their length about two-thirds the distance between their bases; parameres internal, sometimes extreme tips protrude slightly, fig. 14 ..... **arnae**
10. Suranal plate evenly rounded; claspers sickle-shaped, turning laterally; non-fused portion of parameres long, delicate, posteriorly-directed blades, fig. 13 ..... **rufa**

Suranal plate with median process; claspers directed posteriorly or mesally; non-fused portion of parameres complex or directed laterally, figs. 9, 15, 17 11

11. Median process of suranal plate long and slender, extending dorso-anteriorly to membranous abdominal segments; claspers fixed, fig. 9 ..... **rena**

Median process of suranal plate short and stout, directed posteriorly; claspers movable (when removed from groove clasp, fig. 17), figs. 15, 17 12

12. Claspers long, slender and simple-curved, crossed apically; pigmented region of hypandrium a small isolated plate, longer than wide, fig. 15, **punctata**

Claspers long, triple-curved blades, not crossed; hypandrium thin and wide, extending between bases of claspers, fig. 17 ..... **andra**

13. Suranal plate produced into small median, ventrally-curved hook, figs. 8, 42 14

Suranal plate almost evenly rounded 15

14. Claspers extending posteriorly almost touching, fig. 8 ..... **pedicularia**

Claspers sickle-shaped extending postero-laterally, fig. 42 ..... **chapmani**

15. Claspers forked at tip, fig. 1 ..... **anna**

Claspers tapering to simple tip 16

16. Tips of claspers directed postero-laterally, fig. 4 ..... **contraforcepeta**

Tips of claspers directed mesally 17

17. Claspers smoothly tapering, curves slight, fig. 2 ..... **forcepeta**

Claspers distinctly curved as if twisted, fig. 3 ..... **major**

18. Parameres asymmetrical, fig. 10 ..... **kola**

Parameres symmetrical 19

19. Claspers crossed; suranal plate produced into small median hook, fig. 7 .. **pallida**

Claspers separated; suranal plate rounded, figs. 11, 43 20

20. Parameres flared posteriorly; claspers directed downward and antero-laterally, fig. 11 ..... **jeanae**

Parameres slender, tapering at extremities; claspers directed postero-mesally, fig. 43 ..... **nita**

FEMALES

1. Only two small flap-like tips of gonapophyses distinct beyond distal margin of subgenital plate; bases of gonapophyses apparently fused to dorsal interior plate, figs. 29–34 2

Gonapophyses large, distinct, thumb-like flaps; distal margin of subgenital plate (or ventral interior plate) extends posteriorly between gonapophyses, at least mesally, figs. 19–28, 36–40, 44 7

2. Posterior margin of subgenital plate with two wide lateral projections, figs. 29–30 3

Posterior margin of subgenital plate convex, fig. 34, almost straight, figs. 32, 33 or gently concave with a distinct median nick, fig. 31 4

3. Postero-lateral projections of subgenital plate darkly pigmented, mesally-directed hooks, fig. 29 ..... **dona**

Postero-lateral projections of subgenital plate not more heavily pigmented than remainder of plate, truncate tips directed laterally, fig. 30 .... **punctata**

4. Ventral interior plate completely exposed externally posterior of subgenital plate, fig. 31 ..... **kola**

Ventral interior plate completely internal, fig. 32 5

5. Forewings long and tapering, subhyaline, (terminalia, fig. 32) ..... **andra**

Forewings of usual proportions, spotted at ends of veins 6

6. Subgenital plate and ventral interior plate distinct, anterior margin of ventral interior plate with distinct mesal notch, and obliquely truncate laterally, fig. 33 ..... **nubilis**

Subgenital plate and ventral interior plate difficult to differentiate, fig. 34 ..... **arnae**

7. Subgenital plate with an external median flap distally, figs. 25–28, 44 8

Subgenital plate without any external flap 12

8. Flap of subgenital plate a long slender prong, fig. 28 ..... **corona**

Wide flap of subgenital plate forked distally, figs. 25–27, 44 9

9. Two heavily pigmented, longitudinal, internally-ridged structures on dorsal interior plate, fig. 27 ..... **rufa**
Dorsal interior plate lacking any heavily pigmented, internally-ridged structures 10
10. Flap of subgenital plate widest at base, fork extending half way to point of attachment with subgenital plate, fig. 26 ..... **jeanae**
Flap of subgenital plate widest distally, fork extending about one-fourth or less length of flap, figs. 25, 44 11
11. Distance between bases of gonapophyses less than greatest width of either base; posterior margin of subgenital plate abruptly emarginate mesally, fig. 44 ..... **arida**
Distance between bases of gonapophyses about twice the greatest width of either base; posterior margin of subgenital plate slightly concave, fig. 25 ..... **silvicola**
12. Latero-distal corners of subgenital plate sunken and covered by overlapping gonapophyses (very distinct in stained specimens), figs. 19–22 13
Latero-distal corners of subgenital plate curled under, fig. 39, or not sunken and covered by overlapping gonapophyses; subgenital plate sometimes overlaps part of gonapophyses, figs. 23–24, 37–40 16
13. Anterior limits of subgenital plate indistinct; pigmented portion of ventral interior plate lemon-yellow, horizontally oval, figs. 19–20 14
Anterior limits of subgenital plate distinct, especially so laterally, cleft mesally; pigmented portion of ventral interior plate consisting of two small oblique lemon-yellow plates, fig. 22, or ventral interior plate not pigmented, fig. 21 15
14. Notch at anterior limits of ventral interior plate, with a small round protuberance on each side of notch, fig. 20 ..... **forcepeta**
Anterior margin of ventral interior plate horizontal mesally, without notch or protuberances, fig. 19 ..... **major**
15. Pigmented portion of ventral interior plate consisting of two small, oblique, yellow-brown oval areas, fig. 22 ..... **anna**
Ventral interior plate not pigmented, fig. 21 ..... **contraforcepeta**
16. Sense tubercles of paraprocts poorly developed, consisting of one to four sensory hairs; subapterous, fig. 35 ..... **pallida**
Sense tubercles well developed and conspicuous, subapterous to macropterous 17
17. Subgenital plate conspicuously narrowed posteriorly, extending between claspers almost to their tips, figs. 37–39 18
Subgenital plate either almost evenly rounded posteriorly, or almost truncate with ventral interior plate external 20
18. Latero-distal corners of subgenital plate curled under causing distal end of subgenital plate to project from body, pigmentation pale, fig. 39, **chapmani**
Latero-distal corners of subgenital plate not curled under, figs. 37, 38 19
19. Posterior margin of subgenital plate emarginate; proximally on subgenital plate two long pigmented areas laterally; ventral internal plate small and pale, fig. 37 ..... **rena**
Posterior margin of subgenital plate evenly rounded; ventral interior plate large and slightly pigmented, fig. 38 ..... **penta**
20. Ventral interior plate small, pigmented posteriorly, distinctly visible through the subgenital plate, figs. 23, 24, or external and fused with subgenital plate, fig. 40 21
Ventral interior plate not pigmented and not visible through the broad uniformly pigmented subgenital plate, fig. 36 ..... **pedicularia**
21. Ventral interior plate external and extending to lateral margins of subgenital plate; two small, posterior, mesal, transparent projections on posterior margin of ventral interior plate, fig. 40 ..... **nita**
Ventral interior plate narrow, about one-third width of subgenital plate; subgenital plate almost evenly rounded posteriorly 22
22. Ventral interior plate with a triangular notch anteriorly; two longitudinal slightly pigmented regions on dorsal interior plate, fig. 23 ..... **pacifica**
Ventral interior plate with a notch posteriorly; no longitudinal pigmented regions on dorsal interior plate, fig. 24 ..... **telsa**

DESCRIPTION[2] AND DISTRIBUTION OF SPECIES

Lachesilla andra new species

This is a slender light brown species superficially resembling ***kola*** but the terminalia indicate closer relationship with ***nubilis***. It differs from ***nubilis*** in being smaller and uniformly light brown, in having long slender wings and in the terminalia.

MALE.—Length of forewings, 1.9–2.7; width of head, 0.4–0.5; length of antennae, 1.2–1.4.

Head: Light brown, indefinite clouded area on vertex above eyes fading toward ocelli; so-called arms of epicranial suture distinct to antennal fossae; front light brown; ocelli almost white, lateral ocelli much larger than median one; ocellar interval light brown; clypeus and genae uniformly light brown; labrum paler; two basal segments of antennae light brown, remainder of antennae and maxillary palps darker.

Thorax: Light brown, anterior part of middle lobe of meso-thoracic scutum darker; pleura, sterna and legs light brown, legs darker distally. Wings almost hyaline; veins brown; pterostigma subhyaline and about six times longer than its greatest width.

Abdomen: Pale, almost white except for light brown terminalia, fig. 17. Sense tubercles darker brown; paraprocts with light brown posteriorly-directed ventral prongs approximately the same width throughout; suranal plate pale, produced into a single posteriorly-directed hook; parameres fused basally for about half their length forming a Y-shaped structure, expanded distally into thin lobed blades; claspers are triple-curved thin flat sclerotized blades; hypandrium is wide and very short, extending between the bases of the claspers.

FEMALE.—(Brachypterous and macropterous) length of forewings, 1.0–2.0; width of head, 0.45–0.45; length of antennae, 0.7–1.0.

The female is lighter than the male, hence the usual dotted areas of the vertex and lineations of the clypeus are more pronounced. The eyes and ocelli are smaller and the ocellar interval is pale.

Terminalia: Fig. 32. The sense tubercles are slightly darker than the other areas of the terminalia; the gonapophyses are small, pale flaps posterior of the subgenital plate; the central sclerotized portion of the subgenital plate is roughly diamond-shaped (visible in stained specimens); through the subgenital plate can be seen the tan sclerotized ventral interior plate, which is widely and deeply emarginate at its anterior margin; the dorsal interior plate is almost transparent.

Holotype ♂, Giant City State Park, Illinois, October 25, 1944 (sweeping grass) Ross and Sommerman, INHS. *Allotype* ♀, Same data as for holotype. *Paratypes.*—ARKANSAS: Washington Co., Aug. 12, 1942 (light trap) M. W. Sanderson ♂, INHS. CONNECTICUT: Mt. Carmel, Sept. 30, 1943 (sweeping dry grass) K. Sommerman 12 ♂, 5 ♀, KMS, A. H. Sommerman 6♂, 5♀, CU; Mt. Carmel, June 14, 1944

[2]Measurements are stated in millimeters. Those given in the descriptions are the extremes taken from measurements of ten random individuals of each sex, if that many were available. These measurements are included mainly to give some idea of the approximate size of the individuals concerned and are not to be interpreted as rigid limits of extremes.

(sweeping dry grass) A. H. Sommerman 5♂, 41♀, KMS; Mt. Carmel, Aug. 2, 1944 (sweeping grass) A. H. Sommerman ♂, 6 ♀, KMS; Mt. Carmel, Sept. 10, 1944 (sweeping grass) A. H. Sommerman 16 ♂, 9 ♀, KMS; Mt. Carmel, Oct. 9, 1944 (sweeping grass) A. H. Sommerman 7 ♂, 9 ♀, INHS; North Haven, Oct. 23, 1944 (*Andropogon*) A. H. Sommerman 5♂, 3 ♀, INHS. GEORGIA: Fort McPherson, Aug. 2–10, 1943 (light trap) H. Hoogstraal ♂, CNHM, same data but June 25, ♂, KMS; Athens, March 23, 1943 (broomsedge) Odum ♂, ♀, KMS; Cornelia, May 10, 1944 Frison and Ross ♀, INHS. ILLINOIS: Same data as for holotype, 17 ♂, 34 ♀; Lake Glendale, June 14, 1944 (sweeping *Andropogon*) Frison and Sanderson 34 ♂, 49 ♀ (10 ♂, 10 ♀ each USNM, CNM, UCB and 4 ♂, 19 ♀ INHS); Alto Pass, May 8, 1917 ♂, ♀, INHS; Pounds Hollow Lake, July 19, 1944 (on *Andropogon*) Ross and Leighton 3 ♂, 14 ♀, INHS; Olive Branch, Oct. 26, 1944 (on *Andropogon*) Ross and Sommerman 5 ♂, 4 ♀, INHS; Mounds, Oct. 25, 1944 (on corn) Ross and Sommerman ♀, INHS; Giant City State Park, July 6, 1944 (sweeping *Andropogon*) Sanderson and Leighton 8 ♂, 12 ♀, (on cedar) 3 ♂, 5 ♀, INHS; Castle Rock, July 13, 1944 (*Andropogon*) Frison and Sanderson 22 ♀, INHS; La Rue, July 21, 1944, Ross and Leighton 4 ♂, ♀, INHS; Elgin, Aug. 1, 1944 (sweeping) Ross and Sommerman 2 ♀, INHS; Cobden, Oct. 25, 1944 (on corn) Ross and Sommerman ♀, INHS; Thomson, May 25, 1945 (*Andropogon*) Ross and Sanderson ♀, INHS; Ware, Oct. 26, 1944 (on corn) Ross and Sommerman ♀, INHS; Gorham, Oct. 26, 1944 (on corn) Ross and Sommerman ♂, INHS; Sparta, Oct. 26, 1944 (*Andropogon*) Ross and Sommerman ♂, INHS; Herod, Oct. 24, 1944 (*Andropogon*) Ross and Sommerman 29 ♂, 40 ♀, KMS. INDIANA: Beaver Lake Prairie, May 18, 1941 (sweeping dry grass) K. Sommerman 23 ♂, 26 ♀, same data but May 10, 1942, 4 ♂, ♀, KMS; Evansville, June 18, 1943 H. Dybas 2 ♂, 3 ♀, CNHM.

Additional Records.—ILLINOIS: Dubois, May 24, 1917 ♀; Havana, July 5, 1946 (Sand Dunes) Sanderson and Burks ♀; Cottage Grove, Jan. 16, 1946 (in *Andropogon*) Ross and Burks N. MICHIGAN: Midland Co., Sept. 15, 1945 R. R. Dreisbach ♀. NEW JERSEY: Vineland, Sept. 1, 1939 (grass) J. C. Bradley 2 ♂, 2 ♀.

Lachesilla anna new species

This is a medium-size tan species superficially resembling *riegeli*, but the terminalia indicate closer relationship with *contraforcepeta* in the case of the male and *forcepeta* in the case of the female. Superficially it differs from the above-mentioned species in having the wings almost hyaline with very dark veins, cell Cu_{1a} very high and a dark lateral stripe from antennae to abdomen. The claspers of the male are forked at the apex and the interior ventral plate of the female possesses two conspicuously pigmented oval regions.

MALE.—Length of forewings, 1.8–2.1; width of head, 0.5–0.5; length of antennae, 1.6–1.8.

Head: Pale with white flecks, usual dotted areas on vertex distinct; front light brown and long, the clypeus being about as far from the median ocellus as the length of the distal segment of the maxillary palps;

ocelli inconspicuous; ocellar interval light brown; clypeus lineated with twelve mesally-directed tan bands; genae pale, two fuscous stripes extending from dorsal and ventral margin of antennal socket posteriorly to compound eye; labrum pale; antennae and maxillary palps light brown.

Thorax: Dorsum light brown with white spots along some of the sutures; pleura light brown with lateral fuscous stripe just above the base of the coxae; legs pale, especially the coxae and femora. Forewing subhyaline; pterostigma slightly less hyaline; veins dark brown; cell Cu_{1a} almost equilaterally triangular, with inner apex rounded; hind wing hyaline.

Abdomen: Pale ventrally but with prominent dark fuscous stripes extending from pleura across dorsum; terminalia, fig. 1, light brown fading to pale distally. Sense tubercles light brown; paraprocts pale; suranal plate almost evenly rounded; parameres pale, central shaft being several times longer than forks; claspers rounded at base (point of attachment to wider basal sclerite,) flattened distally to fork, inner fork bends dorsally, outer fork laterally; hypandrium rectangular and slightly pigmented.

FEMALE.—Length of forewings, 2.0–2.1; width of head, 0.5–0.5; length of antennae, 0.7–0.8.

The female is lighter than the male hence the lateral stripe and abdominal bands are very conspicuous.

Terminalia: Fig. 22. Sense tubercles are pale but bordered dorsally by a thin fuscous stripe; the gonapophyses are large, pale, mesally-directed flaps that are attached laterally about at the middle of the subgenital plate, overlapping the subgenital plate distally; subgenital plate very pale excepting for two lateral light brown patches at the anterior margin; through the subgenital plate can be see two oblique yellow-brown, oval regions of the ventral interior plate; dorsal interior plate transparent.

Holotype ♂, near Mayview, Illinois, University Woods, Oct. 15, 1944 (dried leaves) K. Sommerman, KMS. *Allotype* ♀, same data as for holotype. *Paratypes.*—CONNECTICUT: Storrs, Aug. 2, 1944 (dried oak leaves) A. H. Sommerman ♂, ♀, KMS; Mt. Carmel, Oct. 12, 1941 (beating Red Pine) K. Sommerman ♂, 3 ♀, (♂, ♀, UCB, 2 ♀,KMS). ILLINOIS: Same data as for holotype, 2 ♀, KMS; Urbana, Brownfield Woods, Sept. 27, 1941 (dried Hackberry leaves) K. Sommerman ♀, KMS, (dried oak leaves) ♀, INHS; Urbana, Oct. 8, 1944 (dried oak leaves) K. Sommerman ♀, KMS; La Rue, Oct. 26, 1944 (dried leaves) Ross and Sommerman ♀, INHS; Palisades State Park, July 14, 1944 (sweeping) Frison and Sanderson 2 ♂, ♀, INHS; Near Mayview, University Woods, Oct. 28, 1944 (oak and maple leaves) K. Sommerman ♂, KMS; Eichorn, Oct. 25, 1944 (dried leaves) Ross and Sommerman ♂, 2 ♀, (♂, ♀, USNM, ♀, INHS).

Lachesilla arida Chapman

Lachesilla arida Chapman (1930, p. 346). ♀.

Only one paratype of this species was available for critical study so the information here presented is almost entirely taken from Chapman, (l. c.).

FEMALE.—Length of forewings, 2.7 mm. av. of 4 indiv.; length of antennae, 2.1 mm. av. of 4 indiv.

This species resembles *silvicola* in general appearance and markings but can be distinguished from it by the veins in the proximal half of forewing being pale yellow, in the distal half brown; the subgenital plate being of definite outline with a basal cleft midway; the distance between bases of gonapophyses less than the greatest width of either base, the posterior margin of the subgenital plate abruptly emarginate mesally, terminalia, fig. 44.

Holotype ♀, Ramsey Canyon, Huachuca Mts., Arizona, Sept. 2, 1927 (in dried oak leaves) J. D. Hood, PJC.

Lachesilla arnae new species

This is a small light brown, spotted-winged species superficially resembling *rena* from which it may be readily distinguished by the bilobed suranal plate and curved, mesally-directed claspers of the male, and the subgenital plate almost completely covering the gonapophyses in the female.

The only specimens available for study were dried material that had been relaxed and cleared *in toto* in KOH; so the intensity of color is not available.

MALE.—Length of forewings, 1.5–1.8; width of head, 0.4–0.45; length of antennae, 1.2–1.4.

Head: Usual dotted areas of vertex distinct and brown; front light brown; ocelli and ocellar interval pale; clypeus with twelve mesally-directed, light brown bands; genae with clouded area below eyes; labrum pale; antennae and maxillary palps brown.

Thorax: Dorsum concolorous with brown areas on vertex, paling along sutures; anterior of middle lobe of mesothoracic scutum darker; pleura and legs light brown, tarsi darker. Forewings hyaline; veins delicate and light brown; pterostigma subhyaline; R and M fused for a distance; veins distinctly margined with bands of brown as follows: R_1 from middle of pterostigma distally, tips of all veins along margin of wing from R_1 to and including Cu_2, Rs to point of fusion with M, along M to point of separation of Cu_1. Hindwings hyaline; brown bordering along tips of R_{2+3}, R_{4+5}, M, Cu and Cu_2.

Abdomen: Pale, excepting for light brown terminalia, fig. 14. Sense tubercles brown; paraprocts with pronounced mesal, posteriorly-directed, blunt prongs; suranal plate bilobed; parameres fused basally to form a stout dark shaft, normally parameres entirely internal, if external then only the distal tips exposed; claspers light brown, slightly curved, almost uniform in width, mesally-directed and fused to basal sclerite; hypandrium broad, rectangular, light brown.

FEMALE.—(Brachypterous and macropterous) length of forewings, 0.5–1.7; width of head, 0.45–0.5; length of antennae, 0.9–1.2.

The female is similar to the male.

Terminalia: Fig. 34. Sense tubercles light brown; gonapophyses small, pale flaps with only the tips protruding posteriorly beyond subgenital plate; subgenital plate, ventral interior plate and dorsal interior plate all almost colorless and transparent.

Holotype ♂, Saskatoon, Saskatchewan, Canada, September 17, 1940 (sweeping native grassland) K. M. King, CNM. *Allotype* ♀, same data as for holotype but August 21. *Paratypes.*—SASKATCHEWAN: Same data as for holotype, ♂, ♀, KMS; Same data as for allotype, 3 ♂, 3 ♀, (♂, ♀, USNM, ♂, ♀, INHS, ♂, ♀, DELSS), same data but Sept. 3, 1940, 2 ♂, 2 ♀ (♂, ♀, DELSS, ♂, ♀, INHS).

Lachesilla chapmani new species

This is a small pale species superficially resembling *nita* from which both sexes may be readily distinguished by the terminalia; cell Cu_{1a} of median height and an interrupted dark ventral stripe from labium along inner margins of coxae to abdomen.

MALE.—Length of forewings, 1.4–1.6; width of head, 0.4–0.5; length of antennae, 1.6–1.7.

Head: Pale, including vertex, ocelli and ocellar interval, front, clypeus, genae and palps; antennae buff; compound eyes black and bulging; interrupted fuscous stripe extending across neck region from eye to base of wings; second interrupted fuscous stripe from base of maxillary palps posteriorly along sternal limits.

Thorax: Pale buff except for interrupted fuscous stripe extending posteriorly along dorsal and ventral margins of pleura; legs pale; forewings almost hyaline, veins pale; hind wings hyaline.

Abdomen: Pale with interrupted lateral fuscous stripe; terminalia, fig. 42, pale buff; suranal plate with small ventrally projecting hook; claspers sickle-shaped, projecting mesally, posteriorly, then laterally; parameres pale, central shaft several times longer than fork; hypandrium pale.

FEMALE.—Length of forewings, 1.6–1.8; width of head, 0.5–0.55; length of antennae, 1.5–1.5.

The color pattern of the females is similar to that of the males. The usual dotted areas on the vertex and the clypeal lineations are more distinct and the front is pale brown.

Terminalia: Fig. 39, pale, gonapophyses large, pale mesally-directed flaps; subgenital plate pale, postero-lateral margins turn in making posterior margin appear almost pointed from ventral view; ventral and dorsal interior plates transparent.

Holotype ♂, Ft. Myers, Florida, February 4, 1933 (dead palm fronds) P. J. Chapman, KMS. *Allotype* ♀, same data as for holotype. *Paratypes.*—FLORIDA: Same data as for holoytpe, 2 ♂, ♀ (♂, KMS, ♂, ♀, PJC); Silver Springs, Feb. 6, 1933 (dead shrubs and palms) P. J. Chapman 2 ♂, 2 ♀ (♂, ♀, INHS, ♂, ♀, USNM).

This species is named for Dr. P. J. Chapman in appreciation of his excellent co-operation during this study.

Lachesilla contraforcepeta Chapman

Lachesilla contraforcepeta Chapman (1930, p. 347). ♂, ♀.

This is a medium-size tan species with uniformly tan or salmon-colored wings, resembling *forcepeta*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 1.6–1.9; width of head, 0.5–0.55; length of antennae, 1.1–1.4.

Terminalia: Fig. 4. Sense tubercles brown; paraprocts pale brown; suranal plate gently rounded, pale brown; parameres fused at base, the central shaft slightly pigmented, external tips lobe-like and colorless; claspers pale tan, twice-bent (at first directed mesally, narrowing to bend, then posteriorly, almost uniform in width to next bend, then postero-laterally), tapering abruptly to tip, fused to elongate, brown, curved, basal sclerite; hypandrium pale brown, wider than long, completely covering area between basal sclerites of claspers.

FEMALE.—Length of forewings, 1.7–1.9; width of head, 0.5–0.55; length of antennae, 1.0–1.2.

Terminalia: Fig. 21. Sense tubercles brown; paraprocts pale, light brown at tips; gonapophyses pale brown, tips curved mesally overlapping postero-lateral corners of subgenital plate; subgenital plate pale brown, distinct in outline, with deep basal cleft mesally, ventral and dorsal interior plates transparent.

Holotype ♂, Ithaca, New York, August 22, 1926 (on Red Cedar) P. J. Chapman, PJC.

Records.—CONNECTICUT: Mt. Carmel, Aug. 10, 1944 (dried oak leaves) A. H. Sommerman ♂, ♀; Mt. Carmel, Oct. 14, 1941 (beating Red pine) K. M. Sommerman ♀. ILLINOIS: Giant City State Park, Monticello, Mt. Carroll, Nora, Palisades State Park, Urbana, Wauconda, White Pines State Park and Zion taken from spruce, cedar, *Andropogon*, pine, tamarack and dried leaves between June 8 and October 25. KANSAS: Lawrence, July 21, 1943 (beating cedar) M. W. Sanderson 16 ♂, 19 ♀. MARYLAND: Plummers Island, June 8, 1913 W. L. McAtee ♀. SASKATCHEWAN: Saskatoon, June 27, 1939 (sweeping grass) K. M. King ♀.

Lachesilla corona Chapman

Lachesilla corona Chapman (1930, p. 350). ♂, ♀.

This is a medium-size light brown species, with subhyaline wings having R_1 darker distally along pterostigma as in *pedicularia*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 2.1–2.3; width of head, 0.5–0.55; length of antennae, 1.6–1.7.

Terminalia: Fig. 12. Sense tubercles brown; paraprocts pale excepting for light brown postero-mesally-directed blunt prongs; suranal plate bilobed, pale, excepting for lateral extremities; parameres short, dark, fused basally for about one-third their entire length, each arm of the "Y" bearing an additional posteriorly-directed process about midway; claspers branched, pale, long, slender processes, outer branches postero-mesally-directed on the oblique, inner branches vary considerably in length, some are directed mesally and curved anteriorly not reaching median line of body, others almost reach median line, then are curved posteriorly with their tips almost touching tips of outer branches; hypandrium wide and short with brown basal sclerites of claspers (two

oblique ovals) fused postero-laterally; brown pigment on several anterior sclerites.

FEMALE.—Length of forewings, 2.0–2.3; width of head, 0.55–0.6; length of antennae, 1.4–1.5.

Terminalia: Fig. 28. Sense tubercles brown; paraprocts light brown mesally; gonapophyses tapering and directed postero-mesally, brown along outer margin, membranous and colorless along inner margin; subgenital plate brown with a long slender tapering prong mesally; ventral interior plate light brown, with a distinct notch in posterior margin, apparently fused posteriorly to the subgenital plate; dorsal interior plate pale, yellow-brown.

Holotype ♂, Spottswood, Virginia, October 4, 1926, Crosby and Bishop, PJC.

Records.—ARKANSAS: Hot Springs, June 19, 1943 T. H. Frison ♀; St. Francis Co., June 22, 1937 (peach orchard) Turner and Anderson ♂. CONNECTICUT: Mt. Carmel, Sept. 27, 1943 (sweeping dry grass) K. Sommerman ♂, ♀, Sept. 15, 1943 (dried leaves) A. H. Sommerman 9 ♂, 13 ♀, Sept. 30, 1943 (sifting dried leaves) K. M. and A. H. Sommerman ♀, Oct. 7, 1943 (dried leaves) K. M. and A. H. Sommerman ♂, 6 ♀. GEORGIA: Putnam Co., Sept. 5, 1936 (on peach foliage) W. F. Turner ♀. ILLINOIS: Apple River Canyon, Bayview, Cairo, Cobden, Eichorn, Elgin Botanical Garden, Enfield, Giant City State Park, Gorham, Grayville, Homer, Keithsburg, La Rue, Makanda, Mayview, Monticello, Mounds, Muncie, Olive Branch, Sherman, Urbana, Ware, and Weldon Springs taken from dried leaves, *Andropogon*, corn, ground-cover and dried brush between May 23 and October 28. INDIANA: Knox Co., July 20, 1938 (peach foliage) W. F. Turner ♂. KANSAS: Lawrence, July 21, 1943 (dried Redbud leaves) M. W. Sanderson ♂, 4 ♀, (dried ash leaves) ♀, beating(cedar) ♀; Lawrence, Oct. 17, 1944 R. H. Beamer 2 ♂, 2 ♀; Douglas Co., Nov. 2, 1944 R. H. Beamer ♀; Onaga (no date) Crevecoeur ♂. MICHIGAN: Cheboygan Co., July 1, 1935 H. B. Hungerford ♂. PENNSYLVANIA: Kenneth Square, Sept. 28, 1939 (ex leaf mould) A. C. Davis ♀. TENNESSEE: Paris, Aug. 11–15, 1943 (light trap) R. L. Wenzel 5 ♂. VIRGINIA: Albemarle Co., June 15, 1940 (from peach) W. F. Turner ♀.

Lachesilla dona new species

This is a large spotted-wing species resembling *punctata* but can be easily distinguished from it by the two lateral projections of the suranal plate and the claspers that do not cross, in the male and by the postero-lateral projections of the subgenital plate produced into two postero-mesally directed hooks in the female.

MALE.—Length of forewings, 2.8–3.0; width of head, 0.55–0.6; length of antennae, 1.9–2.2.

Head: Brown, with the usual spotted areas a darker brown; a pale C-shaped mark extending from base of antennae to ocelli posteriorly almost to posterior margin of vertex where it turns and extends laterally to the eye; so-called arms of epicranial suture distinct to antennal fossae; front brown; ocelli almost white; ocellar interval light brown;

clypeus with fourteen mesally-directed brown bands that almost merge to make a uniformly brown clypeus; genae and labrum light brown; antennae and maxillary palps brown, darkest distally.

Thorax: Brown, pale along dorsal sutures, two darker areas on anterior part of middle lobe of mesothoracic scutum; pleura light brown with sutures dark; legs brown, tarsi darkest. Forewings subhyaline; veins brown, darkest distally; clouded spot at end of all veins excepting Cu_{1b}, clouded region extending far along Cu_{1a}, dark brown spot at end of Cu_2; hindwings almost hyaline with brown veins excepting Cu_2 and 1A, which are colorless; clouded area at end of veins, anterior margin of cell C brown, a distinct brown spot at apex of cell Cu_2.

Abdomen: Pale, with slight indications of stripes, excepting for strongly pigmented terminalia, fig. 16. Sense tubercles light brown but strongly pigmented around base; paraprocts with dark brown, almost black, ventral, posteriorly-directed, flared and flattened prongs with a strongly concave distal margin; suranal plate pale, almost white excepting for brown distal extremities, produced into two prominent lateral, posteriorly-directed projections, each of which bears a smaller ventral protuberance; parameres fused basally for a little more than half their entire length, distally they become complicated "hand-shaped" (with thumb above palm) structures; claspers are curved, slightly mesally-directed, darkest distally and when in place they fit under the parameres near the tip; hypandrium long, conical with rounded cap and extending between the bases of the claspers.

FEMALE.—Length of forewings, 2.4–2.7; width of head, 0.55–0.6; length of antennae, 1.5–1.8.

The female is a little lighter than the male and the pale markings on the head are larger; the so-called arms of the epicranial suture are indistinct and almost touch the clypeus; the eyes are about two-thirds as large as those of the male.

Terminalia: Fig. 29. The terminalia are heavily pigmented and very distinct. The sense tubercles are brown on pale paraprocts; gonapophyses small light brown flaps, darkest basally; posterior margin of subgenital plate produced into two strongly sclerotized and pigmented mesally-directed hooks; subgenital plate less pigmented along mesal line and more transparent; through the subgenital plate can be seen the sclerotized and pigmented ventral interior plate with a mesal fold and mesal projections at anterior margin; dorsal interior plate pigmented excepting in the mesal area with posterior lateral corners drawn out into very distinct brown points.

Holotype ♂, near Hollywood, California, Topanga Canyon, December 25, 1941 (sweeping grass and shrubs) Sommerman and Hasbrouck, KMS. *Allotype* ♀, same data as for holotype. *Paratypes.*—CALIFORNIA: Same data as for holotype, 9 ♂, 9 ♀ (♂, ♀, each INHS and UCB, 7 ♂, 7 ♀, KMS); La Jolla, July 13, 1941 R. H. Beamer ♂, KU; Glenora Angeles Nat. Forest (meadow) July 15, 1944 Shelford et al ♂, ♀, INHS; Hemet, Jan. 13, 1938 (cover sweepings) Christenson and Jones ♂, USNM; Hemet, July 15, 1938 (on peach) Christenson and others ♂, ♀, USNM; Hemet, April 11, 1940 (on peach) Christenson et al ♀, USNM; Yucapia, May 11, 1938 (on peach) Christenson et al ♀, USNM.

Lachesilla forcepeta Chapman

Lachesilla forcepeta Chapman (1930, p. 348). ♂, ♀.

This is a medium-size tan species resembling *contraforcepeta*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 1.5–1.8; width of head, 0.45–0.5; length of antennae, 1.3–1.5.

Terminalia: Fig. 2. Similar in general to *contraforcepeta* excepting for claspers being wide at base, tapering abruptly at about one-third their length then gently tapering to tip which is bent postero-mesally; basal sclerite to which claspers are fused, pale.

FEMALE.—Length of forewings, 1.6–1.8; width of head, 0.45–0.55; length of antennae, 1.1–1.2.

Terminalia: Fig. 20. Sense tubercles brown; paraprocts pale; gonapophyses pale, curved and tapering toward blunt tip, overlapping dorso-lateral corners of subgenital plate; subgenital plate indefinite in outline anteriorly, sometimes pigmented laterally; pigmented region of ventral interior plate a lemon-yellow oval, anterior to this the ventral interior plate is colorless, its anterior margin obliquely tapering mesally where there is a median notch on either side of which is a small dark protuberance (visible sometimes in unstained material); dorsal interior plate colorless.

Holotype ♂, Sea Cliff, Long Island, New York, September 6, 1925 (on dead oak leaves) P. J. Chapman, PJC.

Records.—CONNECTICUT: Mt. Carmel, Oct. 14, 1941 (beating Red pine) K. M. and A. H. Sommerman 8 ♂, 6 ♀, Oct. 12, 1941 3 ♂, 4 ♀; Mt. Carmel, Oct. 4, 1944 (spruce and sweet fern) A. H. Sommerman ♀; Mt. Carmel, Sept. 30, 1943 (beating Red pine) K. M. and A. H. Sommerman ♂, ♀. ILLINOIS: Apple River Canyon, Dongola, Freeport, Giant City State Park, Hillsboro, Momence, Mt. Carroll, Pounds Hollow Lake, Starved Rock State Park, Urbana, Wauconda, White Pines State Park and Zion taken from spruce, juniper, yew, pine, *Andropogon* and grass between May 10 and October 25. KANSAS: Lawrence, July 21, 1943 (beating cedar) M. W. Sanderson ♂, ♀. MARYLAND: Plummers Island, June 8, 1913 W. L. McAtee ♀. MISSOURI: Columbia, June, 1941 (on arm) P. C. Stone ♀. TENNESSEE: Clarksville, July 1, 1939 R. H. Beamer ♀.

Lachesilla jeanae new species

This is a medium-size tan species superficially resembling *contraforcepeta* from which it can be easily distinguished by the non-fused parameres in the male and the posterior flap on the subgenital plate in the female.

MALE.—Length of forewings, 2.2–2.4; width of head, 0.55–0.6; length of antennae, 1.9–2.1.

Head: Pale, with usual clouded areas on vertex light brown; arms of epicranial suture indistinct; front light brown; ocelli pale, median ocellus larger; ocellar interval clouded; clypeus pale with mesally-directed bands indistinct making entire clypeus appear slightly darker than pale areas above antennae; genae pale with clouded area below eye;

fuscous bands extending from dorsal and ventral margin of antennal fossae to eye; small dark area behind eye; labrum pale brown; antennae and maxillary palps light brown.

Thorax: Pale, anterior part of middle lobe of mesothoracic scutum light brown; lateral lobes light brown; pleura pale with faint indications of two lateral stripes, one just below base of wings, other just above base of coxae; legs pale, tarsi light brown. Wings hyaline; pterostigma almost hyaline; veins light brown.

Abdomen: White, with incomplete fuscous stripes extending laterally almost across the dorsum; terminalia, fig. 11, light brown, especially so ventrally; several sternites anterior to hypandrium also light brown. Sense tubercles light brown; paraprocts pale with a small, light brown mesally-directed, pointed prong; suranal plate rounded; parameres separate, widened and flattened distally with several curves and finally tapering to a long tip; claspers short, twisted, inconspicuous processes directed downward and antero-laterally; hypandrium wide and rectangular.

FEMALE.—(Brachypterous) length of forewings, 1.0–1.4; width of head, 0.5–0.65, length of antennae, 1.3–1.7.

The female is a little lighter than the male.

Terminalia: Fig. 26. Sense tubercles brown; paraprocts pale; gonapophyses pale, conspicuous flaps, widest basally and tapering toward tip; subgenital plate large and sclerotized, more heavily pigmented near its latero-anterior margin where there are two swellings, with an external median flap posteriorly which is forked about half way from base to top and is widest at its point of attachment; ventral interior plate fused externally to posterior margin of subgenital plate, posterior of base of flap; dorsal interior plate somewhat sclerotized but not heavily pigmented.

Holotype ♂, Midland, Colorado, Four-mile Creek, August 8, 1943 (Limber pine) J. A. and H. H. Ross, INHS. *Allotype* ♀, same data as for holotype. *Paratypes.*—COLORADO: Same data as for holotype, 20 ♂, 13 ♀ (15 ♂, 8 ♀, INHS, 2 ♂, 2 ♀, each USNM, KMS and ♂, ♀, UCB); Woodland Park, Aug. 4, 1943 (bark of Colorado blue spruce) H. H. and J. A. Ross ♀, INHS.

Records.—COLORADO: Grant (Geneva Park) Aug. 19, 1914 E. C. Jackson 2 ♂; Pingree Park, Aug. 20, 1924 C. R. Crosby ♀. NEW MEXICO: Las Vegas, August and November, 1908 H. S. Barber 3 ♂.

This species is named after Mrs. Jean A. Ross, who has collected many Corrodentia in order to further this study.

Lachesilla kola new species

This is a slender tan species superficially resembling *andra* from which it can be distinguished by the asymmetrical parameres of the male and the external position of the ventral interior plate of the female.

MALE.—Length of forewings, 2.5–2.8; width of head, 0.45–0.5; length of antennae, 1.5–1.9.

Head: Pale, with usual dotted areas tan; ocelli white with black crescents on inner margins; ocellar interval pale connecting with customary light markings resulting in a pale "TT" on the vertex; front

tan; clypeus with eight indistinct, tan, mesally-directed bands (bands fused laterally); genae, maxillary palps and antennae tan; labrum pale.

Thorax: Dorsum tan, pale at sutures; pleura pale, sutures dark; legs pale. Forewings subhyaline; veins tan, with a faint indication of cloudiness at distal ends of veins; hindwings hyaline.

Abdomen: Pale, faintly ringed with dark stripes which fade out ventrally, with tan terminalia, fig. 10. Sense tubercles tan; paraprocts pale with pointed tan, mesally-directed prongs, basally two long slender sclerotized regions; suranal plate pale, bilobed; parameres long, slender, slightly curved, asymmetrical structures, flattened distally and tapering to a point, the left one being hooked basally; claspers (?) posteriorly-directed prongs fused to the hypandrium which is more heavily pigmented laterally.

FEMALE.—Length of forewings, 2.0–2.1; width of head, 0.4–0.5; length of antennae, 1.0–1.1.

The female is similar to the male in markings, but the eyes and ocelli are smaller.

Terminalia: Fig. 31. Tan and distinct, especially so ventrally. Sense tubercles tan; paraprocts pale; gonapophyses small pale flaps posterior of subgenital plate; subgenital plate pigmented laterally and posteriorly, posterior margin concave, with a little flange either side of the center, resulting in a median nick; ventral interior plate wide, completely exposed posteriorly of the subgenital plate, with a slight median carina proximally; dorsal interior plate almost colorless.

Holotype ♂, Ontario, California, October 21, 1938 (on peach) Christenson et al, USNM. *Allotype* ♀, Mesilla Park, New Mexico, December 4, 1939 (cover crop in peach orchard) L. D. Christenson, USNM. *Paratypes.*—CALIFORNIA: Ontario, Oct. 12, 1937 (from peach) Christenson and Jones, 3 ♂, 4 ♀ (♀, USNM, ♂, 2 ♀, INHS, ♂, KMS, ♂, ♀, UCB); Banning, Oct. 4, 1937 (alfalfa) Christenson and Jones, ♂, USNM. NEW MEXICO: Same data as for allotype, ♀, KMS. UTAH: Moab, Sept. 15, 1943 G. F. Knowlton, ♂, INHS.

Lachesilla major Chapman

Lachesilla forcepeta var. *major* Chapman (1930, p. 349). ♂, ♀.

This species resembles *forcepeta*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 1.9–2.0; width of head, 0.5–0.55; length of antennae, 1.6–1.8.

Terminalia: Fig. 3. Similar to *forcepeta* excepting that claspers are narrow at base with distal curve shorter and more pronounced than basal curve.

FEMALE.—Length of forewings, 2.0–2.1; width of head, 0.55–0.6; length of antennae 1.4–1.5.

Terminalia: Fig. 19. Similar to *forcepeta* excepting that anterior margin of colorless portion of ventral interior plate simple, without a notch and two lateral protuberances.

Holotype ♂, Spottswood, Virginia, Oct. 4, 1926 Crosby and Bishop.

Records.—ARKANSAS: Howard Co., Sept. 27, 1937 (peach foliage) Turner and Anderson ♂; Pike Co., Oct. 15, 1936 (peach foliage) Turner

and Anderson ♂. CONNECTICUT: (All records are from Mt. Carmel, collected by K. M. and A. H. Sommerman) Oct. 4, 1942 (dried oak leaves) ♂, ♀; Oct. 9, 1944 (sweeping grass) ♀; Sept. 23, 1944 (sifting leaves) ♀; Oct. 7, 1943 (dried leaves) ♂; Oct. 4, 1943 (spruce and sweet fern) 2 ♂, 3 ♀; Aug. 10, 1944 (dry oak leaves) ♂; Dec. 30, 1939 (dried corn in field) ♀. ILLINOIS: Cairo, Carlisle, Eichorn, Havana, Lake Forest, La Rue, Mayview, Palisades State Park, Shady Rest, Union County, Urbana, Weldon Springs, and White Pines State Park taken from dried corn, dried leaves, in house and at light between June 3 and November 8. MISSOURI: Stoddard Co., June 1, 1937 Turner and Anderson ♀. NEW YORK: Long Pond (Suffolk Co.) Sept. 19, 1926 ♂. NORTH CAROLINA: Nautahala Gap (Macon Co.) Oct. 16, 1926 Crosby and Bishop ♀.

Lachesilla nita new species

This is a medium-size tan species superficially resembling *anna* from which both sexes may be readily distinguished by the terminalia and the light tan wing veins.

MALE.—Length of forewings, 1.7–1.8; width of head, 0.5–0.55; length of antennae, 1.5–1.6.

Head: Pale, usual dotted areas on vertex distinct; front light tan and slightly longer than width of an ocellus, ocelli pale; ocellar interval light tan but fuscous along inner edge of ocelli; clypeus lineated, paler posteriorly; genae pale, two fuscous stripes extending from dorsal and ventral margin of antennal socket posteriorly to compound eye; labrum, antennae and maxillary palps light tan.

Thorax: Dorsum pale mesally, with indefinite light brown stripe on scutum; pleura light brown with lateral fuscous stripe just above base of coxae and a second from eye to wing base; legs pale, especially the coxae and femora. Forewings subhyaline; pterostigma less hyaline; veins light brown with tendency toward cloudiness in cells toward vein tips; cell Cu_{1a} high; hindwing hyaline.

Abdomen: Pale ventrally but with prominent stripes extending from pleura across dorsum; terminalia, fig. 43, light tan; sense tubercles and paraprocts light tan, pale prongs of paraprocts mesally-directed; suranal plate rectangular, but because of curvature it appears to be evenly rounded; parameres pale, slender and curved; claspers fused to hypandrium; hypandrium pale with transverse median groove, very evident in lateral view.

FEMALE.—Length of forewings, 1.9–2.0; width of head, 0.55–0.6; length of antennae, 1.3–1.5.

The color pattern of the female is the same as the male but the color intensity is not so pronounced.

Terminalia: Fig. 40. Pale, gonapophyses medium-size flaps with postero-mesally-directed prong on distal margin; subgenital plate pale with pigmented lateral areas; ventral interior plate (with two mesal points on distal margin) external and fused to posterior margin of subgenital plate; dorsal interior plate transparent.

Holotype ♂, Apopka, Florida, February 6, 1933 (live oak and willow oak) P. J. Chapman, KMS. *Allotype* ♀, Same data as for holotype.

Paratypes.—FLORIDA: same data as for holotype ♂, 3 ♀ (♂, ♀, PJC, 2 ♀, INHS); Lake Jackson, Leon Co., April 12, 1927 C. R. Crosby ♀, PJC. GEORGIA: Savannah, Jan. 31, 1933 (dead limb) P. J. Chapman ♀, KMS.

Lachesilla nubilis (Aaron)

Caecilius nubilis Aaron (1886, p. 13).
Lachesilla nubilis Chapman (1930, p. 351). ♂, ♀.

This is a rather large brown spotted-winged species resembling *punctata*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 2.2–2.5; width of head, 0.6–0.6; length of antennae, 1.7–1.8.

Terminalia: Fig. 18. Sense tubercles dark brown; paraprocts brown, with strongly sclerotized, posteriorly-directed, short, pointed, mesal prongs; suranal plate with two pale lateral lobes; parameres fused basally, sometimes basal tip broad, forked external part of parameres complicated and lobed with innermost part tapering posteriorly to a rounded point, the whole becoming external about one-half way up length of claspers; claspers sclerotized, light tan, twice-curved, posteriorly-directed blades, attached basally to a pincer-shaped basal sclerite; hypandrium brown, drawn out laterally at base, not covering entire distance between bases of claspers.

FEMALE.—Length of forewings, 2.1–2.3; width of head, 0.55–0.6; length of antennae, 1.4–1.6.

Terminalia: Fig. 33. Sense tubercles brown; paraprocts pale; gonapophyses small light brown flaps posterior of subgenital plate; subgenital plate broad, brown laterally, pale mesally; ventral interior plate shows through subgenital plate very plainly, light brown with anterior margin obliquely truncate laterally and a distinct median notch; dorsal interior plate light brown with postero-lateral angles drawn out into a point.

Holotype, Southern Texas (beating live oak thicket) Aaron, PANS.

Records.—ALABAMA: Escambia Co., March 10, 1937 Turner and Anderson ♀. ARKANSAS: Washington Co., Aug. 12–28, 1942 (light trap) M. W. Sanderson 11 ♂, 4 ♀, July 10–29, 1940 (light trap) M. W. Sanderson 3 ♂; Fayetteville, Aug. 16, 1941 (at light) M. W. Sanderson ♀; Howard Co., May 13, 1938 (weeds in orchard) W. F. Turner ♂; Howard Co., Dec. 8, 1938 W. F. Turner ♀; Howard Co., April 9, 1937 (weeds) W. F. Turner ♂, ♀; Howard Co., Sept. 24, 1937 (weeds) Turner and Anderson ♂; Washington, March 24, 1938 (sweeping) W. F. Turner ♀. COLORADO: Woodland Park Aug. 4, 1943 H. H. Ross ♀. CONNECTICUT: Mt. Carmel, Sept. 30, 1943 (dried corn) K. M. and A. H. Sommerman ♀. GEORGIA: Fort McPherson, June 3–Sept. 2, 1943 (light trap) H. Hoogstraal 48 ♂, 20 ♀; Cornelia, May 10, 1944 Frison and Ross 2 ♂, 7 ♀; Gainesville, May 9, 1944 Frison and Ross 2 ♂, 4 ♀; Peach Co., April 28, 1937 Turner and Anderson ♀; Upson Co., March 5–7, 1938 (peach orchard) W. F. Turner ♂. ILLINOIS: Throughout the state taken from dry organic material between April 4 and Dec. 12. INDIANA: Evansville, June 21, 1943 (at light) H. Dybas ♂; Beaver Lake Prairie, May 18, 1941 (sweeping dry grass) K. Sommer-

man 9 ♀; Jackson Co., June 27, 1938 (on willow) B. E. M. ♂. IOWA: County No. 35, Aug. 24, 1933 Barker ♀. KANSAS: Bloom, Douglas County, Harper County, Lawrence, Manhattan, Meade County, Medora, Onaga, Pratt, Riley County and Sedan taken from grass, corn, wheat, yucca pods and at light between April 17 and Nov. 11. KENTUCKY: Wickliffe, April 15, 1941 (floodplain sweeping) K. Sommerman 2 ♂; Sturgis, July 4, 1941 J. S. Ayars ♀. LOUISIANA: Tallulah, Aug. 30, 1934 (ex. cotton) P. M. Gilmer ♂; Tallulah, Nov. 6, 1929 (3,000 ft. airplane insect trap) P. A. Glick ♀; Bossier Parish, April 12, 1937 W. F. Turner ♂. MICHIGAN: Paw Paw, Aug. 31, 1942 J. S. Ayars ♂; Hart, June 19, 1939 C. W. Sabrosky ♂; Cheboygan Co., July 14, 1940 R. I. Sailer ♀; Shelby, June 21, 1939 C. W. Sabrosky ♂; Breedsville, 1929 N. Fuller ♂. MINNESOTA: St. Paul, Aug. 17, 1921 W. E. Hoffman ♂. MISSISSIPPI: Lincoln Co., March 10, 1939 (peach orchard) W. F. Turner ♀. MISSOURI: For the following nine localities all from corn in the field taken by T. F. Winburn; 7 mi. E. of Carrolton, Oct. 22, 1940 11 ♂, 15 ♀; Hannibal, Oct. 29, 1940 ♂, 3 ♀; High Hill, Oct. 15, 1940 ♂, 4 ♀; 2 mi. S. of Jacksonville, Oct. 15, 1940 8 ♂, 9 ♀; Keytesville, Oct. 21, 1940 8 ♂, 7 ♀; Lamine, Oct. 17, 1940 6 ♂, 5 ♀; Montgomery City, Oct. 15, 1940 23 ♂, 33 ♀; Norborne, Oct. 22, 1940 27 ♂, 22 ♀; and Richmond, Oct. 22, 1940 38 ♂, 19 ♀; Columbia, July 30, 1940 (on corn) P. C. Stone ♀; Palmyra, Sept. 4, 1940 G. T. Riegel 2 ♂; Macon, June 8, 1941 H. Dybas 2 ♂, 2 ♀; Boschertown, May 4, 1932 (on *Helianthus annuus*) Satterthwait 2 ♂; and Scott Co., Nov. 9, 1937 (under leaves) W. F. Turner ♀. NEW MEXICO: Tucumcari, Jan. 3, 1942 (sweeping sunflower) K. Sommerman ♂; Albuquerque, March 3, 1928 (cover sweeping) Christenson and Jones 3 ♂, 3 ♀. NORTH CAROLINA: For the following four records all from Raleigh taken by H. F. Schoof, Sept. 15, 1940 (dried corn) ♀; Jan. 6, 1941 (cotton bolls) ♂♂, ♀♀; March 15, 1941 (okra) 21 ♂, 34 ♀; March 12, 1941 (dried corn) ♂♂, ♀♀; Swain, May 10, 1944 Frison and Ross ♂, ♀; Raleigh, May 5, 1934 C. S. Brimley ♀; Raleigh, Aug. 7, 1938 Wilson ♂; Reidsville, June 27, 1905 (in wheat straw) F. Sherman ♀. OHIO: Mt. Healthy, May, 1942 (light trap) 3 ♂. OKLAHOMA: Comanche Co., (13) 3 ♂, 4 ♀. SOUTH CAROLINA: Columbia, July 10, 1943 (light trap) H. Hoogstraal ♂, 2 ♀; Clemson College, April 4, 1934 ♂; Saluda Co., June 22, 1938 W. F. Turner 2 ♀; Saluda Co., March 3, 1938 W. F. Turner (from peach) ♀. SOUTH DAKOTA: Brookings, Aug. 30, 1943 (light trap) H. C. Severins ♂. TENNESSEE: Sandburg, April 14, 1941 (sweeping shrubs) K. Sommerman 3 ♂, ♀; Parksville, April 25, 1938 Ross and Burks ♂; Sevierville, June 12, 1940 Frison et al ♂; Paris, June 21–Aug. 15, 1943 (at light) R. L. Wenzel 50 ♂, 14 ♀; Harriman, 1933 H. G. Butler 2 ♂; Roane Co., Dec. 15, 1936 Turner and Anderson ♂. TEXAS: Fort Worth, Feb. 5–10, 1944 (sweeping old vegetation and cotton) J. E. Porter 6 ♂, 11 ♀; Brownwood, June 7, R. H. Painter ♀; Dallas, Sept. 20, 1906 F. C. Pratt ♀; Dallas, Feb. 27, 1908 (on window) E. S. Tucker ♀; Dallas, March 16, 1908 F. C. Bishop ♀; Calvert, Feb. 27, 1908 C. R. Jones 2 ♂, 4 ♀; Victoria, J. D. Mitchell ♂; Texarkana, March 28, 1908 (on corn) E. S. Tucker ♀; Denison, July 7, 1939 (cover sweeping) Christenson and Jones ♂; Bangs, Feb. 16, 1939 (cover sweeping) L. S. Jones 6 ♂, ♀; Tyler, Feb. 23, 1938 (cover sweeping)

Christenson and Jones ♀. UTAH: Moab, Sept. 15, 1943 G. F. Knowlton ♂; Green River, June 14, 1945 G. F. Knowlton ♂; Orangeville, Sept. 6, 1945 (on alfalfa) G. F. Knowlton ♂. VIRGINIA: Danville, May 3, 1944 (at light) Frison and Ross ♂, 4 ♀; Arlington Farms, Aug. 19, 1932 (on corn) J. V. Scrivener ♂. SASKATCHEWAN: Saskatoon, Sept. 17, 1940 (native grassland) K. M. King ♀.

Lachesilla pacifica Chapman

Lachesilla pacifica Chapman (1930, p. 353). ♀.

This is a medium-size light brown species superficially resembling *contraforcepeta*. For a complete description of color characters see Chapman, (l. c.).

FEMALE.—Length of forewings, 1.6–1.9; width of head, 0.5–0.5; length of antennae, 1.0–1.2.

Terminalia: Fig. 23. Sense tubercles brown; paraprocts light brown; gonapophyses light brown, darker along outside margin, curved mesally; subgenital plate broad, pale, posterior margin curved with gentle median concavity; ventral interior plate distinct brown, at posterior margin of subgenital plate, with a triangular anterior cleft; dorsal interior plate colorless excepting for two pale stripes one on either side medianly, anterior of the ventral interior plate.

Holotype ♀, Seattle, Washington, August 7, 1927, C. R. Crosby, PJC.

Records.—CALIFORNIA: Yuba City, Sept. 19, 1938 (on peach) Christenson et al ♀; Berkeley, April 11, 1943 (apricot tree) C. A. Fleschner ♀. COLORADO: Buena Vista (Collegiate Peaks) Aug. 5, 1943 J. A. and H. H. Ross ♀. BRITISH COLUMBIA: Kaslo, Aug. 1 R. P. Currie 2 ♀; University, Oct., 1928 G. J. Spencer 5 ♀.

Lachesilla pallida (Chap.)

Terracaecilius pallidus Chapman (1930, p. 343). ♀.

This is a rather large brown species most closely related to *pedicularia* but can be easily distinguished from it by its large size. In the male the distal half of pterostigma is pigmented, a fumose band extends from Cu_{1a} to M, and the claspers are crossed. The sense tubercles of the female are inconspicuous and she is almost apterous, the wings being reduced to thick fleshy pads.

MALE.—Length of forewings, 1.9–2.3; width of head, 0.6–0.6; length of antennae, 1.7–1.9.

Head: Brown, usual spotted areas of vertex distinct; front brown; ocelli white; ocellar interval almost black; clypeus and genae brown, a little lighter along margin; labrum, antennae and maxillary palps brown.

Thorax: Dorsum dark brown; pleura lighter; legs same as antennae, brown. Forewings hyaline; veins brown; pterostigma opaque, distal half brown; clouded at tip of veins at margin, fumose along both sides of vein Cu_{1a} and extending across to M, distinct brown spot at end of Cu_2.

Abdomen: Pale, ringed with dark brown stripes across dorsum and continued ventrally across the sternites, but not so dark; terminalia, fig. 7, brown. Sense tubercles brown; paraprocts pale excepting for two

light brown areas mesally below sense tubercles, which bear postero-mesally-directed slender prongs; suranal plate produced into a small median, postero-ventrally-directed hook; parameres separate, tips at base very close; claspers, short brown crossed hooks; hypandrium dark brown and wide, fused to basal sclerites of claspers; anterior sternite brown.

FEMALE.—(Subapterous) length of forewings, 0.25–0.3; width of head, 0.6–0.65; length of antennae, 1.4–1.7.

Agrees in general with Chapman's description excepting that the legs are armed with ctenidia and sense tubercles of the paraprocts are inconspicuous, consisting of from one to four sense hairs on membranous circles; forewings are somewhat like nymphal wing pads with a few scattered hairs; posterior wings reduced to tiny protrusions lying beneath forewings.

Terminalia: Fig. 35. Concolorous with head; sense tubercles near dorsal basal corner of paraprocts; gonapophyses brown, arm-like, tapering at end but bluntly pointed; subgenital plate broad, convex, with drawn-out ends at base, apically blunt-pointed and non-pigmented; interior plates transparent.

Holotype ♀, Ithaca, New York, July 12, 1925 P. J. Chapman, PJC. *Allotype* ♂, Urbana, Illinois, October 16, 1944 (sifting leaves) K. Sommerman, KMS.

Records.—ILLINOIS: Urbana, Oct. 7, 1944 (sifting leaves) K. Sommerman 3 ♂, 3N♂; Urbana, Sept. 17, 1944 (sifting) K. Sommerman 5 ♂, 19 ♀, 17N♂, 16N♀; N of Mayview, Oct. 1, 1944 (sifting leaves) K. Sommerman ♀, N♂; Apple River Canyon State Park, Aug. 11, 1944 (ground cover) Sanderson and Leighton ♀; Muncie, Sept. 24, 1944 (sifting leaves) Ross and Sommerman ♂, ♀, 2N♀; Urbana, Sept. 17, 1944 (sifting leaves) K. Sommerman 2 ♂, 7 ♀; Urbana, Sept. 24, 1944 (sifting leaves) K. Sommerman 11 ♀, 24N♀; Urbana, Oct. 16, 1944 (sifting leaves) K. Sommerman 2 ♂, 4 ♀, N♂; Urbana, Oct. 14, 1944 (sifting leaves) K. Sommerman 2 ♂, 6 ♀, 2N♀; Clayton, Sept. 30, 1916 ♂; White Heath, June 24, 1916 ♂; Hopedale, Oct. 2, 1917 ♂; Urbana, July 22, 1945 (sifting) K. Sommerman 2 ♀, 2N♂, N♀; Urbana, July 29, 1945 (sifting) K. Sommerman 2 ♀. NEW YORK: Ithaca, July 12, 1925 P. J. Chapman 2 ♀.

Lachesilla pedicularia (L.)

Hemerobius pedicularius Linnaeus (1758, p. 551).
Termes fatidicum Linnaeus (1758, p. 610). (See Gurney, 1939).
Lachesilla pedicularia Chapman (1930, p. 384). ♂, ♀.

A nearly complete synonymy of this species appears in Enderlein, 1915.

This is a small to medium-size brown species with hyaline wings darkly veined. For a complete general description see Chapman, (l. c.).

MALE.—(Brachypterous to macropterous) length of forewings, 0.3–1.7; width of head, 0.35–0.5; length of antennae, 1.0–1.7.

Terminalia: Fig. 8. Sense tubercles brown; paraprocts pale excepting for ventral brown area antero-mesally of sense tubercles; suranal plate produced into a small median, postero-ventrally-directed hook;

parameres fused basally, arms projecting laterally almost T-shaped; claspers mesally touching, posteriorly-directed, pointed processes about as long as anterior-posterior length of hypandrium; basal sclerites of claspers fused to hypandrium, the whole being broad with concave posterior margin.

FEMALE.—(Subapterous to macropterous) length of forewings, 0.1–1.9; width of head, 0.4–0.45; length of antennae, 0.9–1.4.

Terminalia: Fig. 36. Sense tubercles brown; paraprocts lighter brown; gonapophyses conspicuous brown mesally-directed, bluntly rounded flaps; subgenital plate broad, brown, emarginate anteriorly; ventral interior plate and dorsal interior plate transparent.

Types, Disposition unknown to me.

Records.—ARKANSAS: Washington Co., Aug. 19, 1942 (light trap) M. W. Sanderson ♀. CONNECTICUT: Mt. Carmel, Aug. 2–Oct. 14, 1941–'44 from corn and dried grass taken by K. M. and A. H. Sommerman 88 ♂, 68 ♀. ILLINOIS: Algonquin, Anna, Belvidere, Chicago, Champaign, Dongola, Elizabeth, Farmington, Glen Ellyn, Gorham, Hillsboro, Illiopolis, Johnson City, Lake Forest, Litchfield, Livingston Co., Marissa, Metropolis, Millshoals, Morris, Mt. Carmel, Palisades State Park, Pembroke, Shepherd, St. Anne, St. Jacob, Urbana, Ware, Watson, White Heath and White Pines State Park taken from dry organic material in dwellings and out-of-doors the year around. INDIANA: Fort Harrison, Aug. 12, 1942 (on windows) R. Traub 7 ♂, 10 ♀; Knox Co., July 20, 1938 (swept from peach) W. F. Turner ♂, ♀. IOWA: Ames, Aug. 29, 1924 H. L. Sweetman ♀; Cherokee, Sept. 22, 1940 (in fermenting barley) R. T. Cotton ♂♂; ♀♀. KANSAS: Meade Co., Sept. 13, 1944 R. H. Beamer ♂, ♀; Douglas Co., Oct. 22, 1944 (freshly painted house) R. H. Beamer 5 ♂, ♀; Onaga, Oct. 16, 1929 (on window) Crevecoeur 2 ♂, 2 ♀; Manhattan, May 19, 1929 R. H. Painter 2 ♀; Blair, June 24, 1937 P. G. Lamers ♂. KENTUCKY: Lexington, Sept. 14, 1927 (infesting dwelling) Mrs. Rogers 2 ♂, 4 ♀. MARYLAND: Washington, D. C., July 25, 1906 W. L. McAtee ♂, 2 ♀. MICHIGAN: East Lansing, June 2, 1941 C. Sabrosky ♂, ♀; East Lansing, Aug. 18, 1942 (walls of new house) C. Sabrosky 5 ♂, 3 ♀; Midland Co., June 21, 1945 R. R. Dreisbach ♀. MINNESOTA: St. Paul, 1941 (storage bin of corn) 2 ♂; Thief River Falls, Aug. 18, 1932 H. H. Shepard ♂, 4 ♀. MISSOURI: Columbia, Aug. 14, 1940 (in weather cabinet) P. C. Stone 8 ♂, 5 ♀; Columbia, Aug. 15, 1940 (ant carrying psocid) P. C. Stone ♀; Macon, June 8, 1941 H. Dybas 2 ♂; Scott Co., Sept. 24, 1936 (on peach foliage) W. F. Turner ♂; 7 mi. E. of Carrolton, Hannibal, 2 mi. S. of Jacksonville, Keytesville, Norborne and Richmond taken from corn in the field between October 15 and 22, 1940 by T. F. Winburn. NEW HAMPSHIRE: Mt. Washington, July 9, 1933 (Alt. 4,000) C. P. Alexander 2 ♂. NEW MEXICO: Las Vegas, May 8 H. S. Barber ♀. NEW YORK: Moravia, Oct. 11, 1922 C. R. Crosby ♂, ♀; Moravia, Sept. 3, 1922 (in house) H. McLean ♂, 2 ♀; Aurora, Sept. 30–Oct. 20, 1945 (dried leaves and dried corn) K. Sommerman 13 ♂, 28 ♀. NORTH DAKOTA: Wahpeton, Oct. 8, 1941 (wheat and barley) Hoel 20 ♂, 10 ♀; Walcott, Sept. 29, 1941 (barley granary) H. G. Grott 66 ♂, 58 ♀; Valley City, Oct. 2, 1941 (granary) C. Metcalf 114 ♂, 103 ♀; Langdon, Oct. 8, 1940 H. Stelford 2 ♂, 10 ♀. PENNSYLVANIA: State College, Sept. 15, 1941

S. W. Frost 137 ♂, 159 ♀; Arendtsville, Nov. 2, 1922 S. W. Frost 3 ♂, 5 ♀. SOUTH DAKOTA: Meckling, Sept. 28, 1940 (barley) ♂, ♀; Fandreau, Oct. 8, 1940 (oats) ♂, 6 ♀. TEXAS: Dallas, April 15, 1908 F. C. Bishop ♂, ♀. UTAH: Provo, Aug. 23, 1938 (on peach) Christenson et al ♂. VIRGINIA: Falls Church, Sept. 12 N. Banks 3 ♀. WASHINGTON: Wenatchee, Sept. 7, 1938 (cherry foliage) Christenson et al ♂. BRITISH COLUMBIA: Kaslo, June 25 R. P. Currie ♀. SASKATCHEWAN: Saskatoon, Aug. 31, 1938 (grass) K. M. King ♀.

Lachesilla penta new species

This is a small tan species superficially resembling *forcepeta* from which it may be easily distinguished by the terminalia.

The only specimens available for study were dried material that had been relaxed and cleared *in toto* in KOH; so the intensity of color is not available.

MALE.—Length of wings, 1.8; width of head, 0.5.

Head: Light tan with usual dotted areas on vertex and lineations on clypeus.

Thorax: Concolorous with head, with color more intense on dorsum.

Abdomen: Terminalia, fig. 41, light tan; suranal plate bilobed with the tips of the lobes thickened forming ventrally curved knobs; paraprocts bearing mesally-directed prongs; claspers curved, posteriorly flattened blades abruptly narrowed at tip; parameres pale, fused forming a central shaft; hypandrium broad and pale, posteriorly drawn out into an acute mesal point.

FEMALE.—Length of forewings, 1.9; width of head, 0.6.

As near as can be determined the color pattern of the female is similar to that of the male.

Terminalia: Fig. 38. Pale, gonapophyses large, postero-mesally-directed flaps, in ventral view appearing much wider distally than basally; subgenital plate pale, broad and narrowed posteriorly, the distal part abruptly sunken; ventral internal plate broad with lateral limits more heavily pigmented; dorsal interior plate transparent.

Holotype ♂, Brownsville, Texas, May 2, 1904 H. S. Barber, USNM. *Allotype* ♀, same data as for holotype.

Lachesilla punctata (Banks)

Elipsocus punctatus Banks (1905, p. 1). ♂.
Lachesilla punctata Chapman (1930, p. 357). ♂, ♀.

This species superficially resembles *nubilis* or *dona*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 3.0–3.4; width of head, 0.6–0.6; length of antennae, 1.7–1.9.

Terminalia: Fig. 15. Sense tubercles brown; paraprocts brown with posteriorly-directed, dark, sclerotized prongs; suranal plate pale, produced into a stout median posteriorly-directed hook, dark and sclerotized at tip; parameres fused at base, forming a long slender central shaft; arms branched again, the inner branches expanded distally into wide plates that form inner groove of groove clasp, apically the outer arm presses

against clasper too; claspers brown and heavily sclerotized, long slender processes that cross apically; hypandrium a small, narrow brown plate, basally between claspers.

FEMALE.—Length of forewings, 2.3–2.4; width of head, 0.6–0.6; length of antennae, 1.5–1.6.

Terminalia: Fig. 30. Sense tubercles brown; paraprocts pale; gonapophyses small, pale, postero-mesally-directed flaps exposed beyond subgenital plate; subgenital plate brown, with two truncate, posterolaterally projecting corners, with a median flap (part of ventral interior plate?) between them; ventral interior plate pale with deep median notch posteriorly; dorsal interior plate pale brown.

Holotype ♂, San Mateo Co., California, Baker MCZ.

Records.—ARIZONA: Sedona, Dec. 13, 1929 (peach foliage) L. D. Christenson ♂. CALIFORNIA: East Oakland, Feb. 22, 1936 P. W. McKinstry 2 ♀; Monterey, July 22, 1935 R. H. Beamer ♂; Albany, March 1, 1936 P. W. McKinstry 6 ♂, 5 ♀; Berkeley, Nov. 16, 1914 ♂; Berkeley, Oct. 14, 1915 E. O. Essig ♂. NEW MEXICO: Espanola, Nov. 4, 1938 (on clover) Christenson et al ♂.

Lachesilla rena new species

This is a small light brown spotted-winged species closely related to *pallida*, from which it differs by being macropterous in both sexes, having claspers of male not crossed, parameres fused, and having subgenital plate of female pigmented only as lateral strips, and posterior margin of subgenital plate narrowed.

MALE.—Length of forewings, 1.5–1.7; width of head, 0.4–0.45; length of antennae, 1.3–1.5.

Head: Pale, usual spotted areas of vertex small, light brown; so-called arms of epicranial suture distinct to antennal fossae; front light brown; ocelli pale; ocellar interval pale; twelve distinct brown mesally-directed bands on clypeus, lateral ones darker; genae clouded; antennal fossae bordered with brown; labrum and labial palps light brown; antennae pale proximally, brown distally.

Thorax: Dorsum pale, two brown areas on anterior part of middle lobe of mesothoracic scutum; lateral lobes pale brown; sutures pale; pleura light brown, sutures dark, with a very faint fuscous lateral stripe just above the coxae; legs light brown. Forewings subhyaline with distinct brown clouded areas at distal ends of veins, an interrupted brown band from end of Cu_2 to base of pterostigma, likwise from cell Cu_{1a} to tip of pterostigma; veins light brown; pterostigma opaque; hindwing hyaline, clouded at ends of veins; spot at end of cell Cu_2.

Abdomen: Pale, with indication laterally of fuscous rings; terminalia, fig. 9, light brown. Sense tubercles and paraprocts light brown; long, stout, dark, sclerotized, posteriorly-directed prongs mesally on paraprocts; suranal plate rounded and produced dorsally into a long, slender, anteriorly-directed process; parameres fused basally about two-thirds of their length; claspers short, posteriorly-directed, almost touching; hypandrium fused to basal sclerites of claspers.

FEMALE.—Length of forewings, 1.6–1.7; width of head, 0.4–0.45; length of antennae, 0.9–1.1.

The female is similar to the male excepting that the clouded areas on the forewing are so confined to the veins that there is no suggestion of bands across the wing; abdominal rings more conspicuous.

Terminalia: Fig. 37. Sense tubercles brown; paraprocts pale; gonapophyses short, enlarged basally and tapering to blunt point, light brown basally and laterally; subgenital plate narrowed posteriorly, projecting between claspers, posterior margin with median cleft, apparently weakened region at end of lateral pigmentation because the whole narrow tip can be bent forward like a flap, flap pale brown, dark at notch; ventral interior plate with two median pigmented bands that fuse posteriorly; dorsal interior plate with a pale transverse band between claspers.

Holotype ♂, Phoenix, Arizona, July 9, 1937 (cover sweepings in orchard) Christenson and Jones, USNM. *Allotype* ♀, same data as for holotype. *Paratypes.*—ARIZONA: Same data as for holotype, 6 ♂ (4 ♂, USNM, 2 ♂, KMS); Glendale, Dec. 16, 1939 (on grass) L. D. Christenson, 9 ♂, USNM; Phoenix, July 9, 1937 (from peach) Christenson and Jones, ♀, USNM; Mesa, May 28, 1938 (cover sweepings) Christenson et al, ♂, ♀, INHS; Phoenix, Sept. 14, 1937 (on foliage and cover) Christenson and Claney, ♂, ♀, KMS. CALIFORNIA: Hemet, Oct. 26, 1938 (in soil) Christenson et al, ♂, USNM; Hemet, July 29, 1940 (ex cover in orchard) Christenson and Jones, ♂, USNM. TEXAS: Brownwood, L. S. Jones, ♂, USNM.

Lachesilla riegeli new species

This is a medium-size tan species superficially resembling *anna* from which it may be easily distinguished by the two pairs of so-called claspers, stout shaft of parameres and posteriorly-directed prongs of paraprocts in the male.

MALE.—Length of forewings, 1.9; width of head, 0.5; length of antennae, 1.5.

Head: Pale, usual dotted areas on vertex light brown; brown stripe from anterior end of epicranial suture to antennal fossae, another from front to outer posterior margins of lateral ocelli; front brown; ocelli white; ocellar interval light brown; twelve pronounced, brown, mesally-directed bands on clypeus; brown streak from dorsal and ventral margin of antennal fossae posteriorly to eye; genae clouded; maxillary palps pale excepting for last segment which is brown, antennae brown.

Thorax: Dorsum brown, pale at sutures; two darker areas anteriorly on lobe of mesothoracic scutum; pleura light brown, sutures dark, a faint fuscous streak laterally just above the coxae; legs pale, tarsi darkest.

Abdomen: Pale, ringed with fuscous stripes; terminalia, fig. 5, brown. Sense tubercles brown; paraprocts lighter with prominent tan, pointed, posteriorly-directed prongs mesally; suranal plate pale, bilobed, with two yellow-brown, postero-dorsally-directed median hooks (almost fused); parameres fused and expanded basally, stout and dark. (There is a question in my mind concerning the inner pair of so-called claspers. Might they be the external part of the parameres as in *corona* ?) Two pairs of so-called yellow-brown claspers present, the laterad pair having prominent bases with a tapering shaft, turned postero-laterally at

apex, mesad pair about one-half length of others, tapering with tips slightly turned laterally; a membranous area below claspers excepting where they are fused at a point to their basal sclerite laterally; hypandrium wide, brown.

Holotype ♂, Miami Beach, Florida, May 17, 1945 (at blue light) R. A. and G. T. Riegel, KMS.

This species is named after G. T. Riegel who has contributed as a gift several collections of Corrodentia.

Lachesilla rufa (Walsh)

P(socus) rufus Walsh (1863, p. 185).
Caecilius rufus Hagen (1866, p. 206).
Caecilius impacatus Aaron (1866, p. 14). ♂.
Pterodela rufa Enderlein (1906, p. 319).
Lachesilla rufa Chapman (1930, p. 358). ♂, ♀.

This is a large tan species with subhyaline wings. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 2.7–3.2; width of head, 0.6–0.65; length of antennae, 2.0–2.5.

Terminalia: Fig. 13. Sense tubercles brown; paraprocts pale with posteriorly-directed, light brown, pointed prongs; suranal plate pale, rounded; parameres fused at base, central shaft short, posterior arms long, slender, almost colorless blades; claspers sickle-shaped, tips directed postero-laterally, fused basally to a dark brown sclerite; hypandrium brown, darker basally, with a brown concave sclerotized band along posterior margin.

FEMALE.—Length of forewings, 2.5–3.0; width of head, 0.6–0.7; length of antennae, 1.6–1.9.

Terminalia: Fig. 27. Sense tubercles brown; paraprocts pale brown; gonapophyses pale, darker at base; basal sclerite slightly darker; subgenital plate broad, brown laterally, pale mesally, with a colorless forked flap distally, which is opaque at its base; light brown ventral interior plate external, fused to posterior of subgenital plate; dorsal interior plate with two dark longitudinal internal ridges, brown laterally, with a broad band along posterior margin.

Holotype.—According to Chapman the type of *rufa* is non-existant.

Records.—CONNECTICUT: Mt. Carmel between July 25 and Nov. 4 taken from dried leaves K. M. and A. H. Sommerman 59 ♂, 89 ♀. GEORGIA: Ft. McPherson, Aug. 2–31, 1943 (light trap) H. Hoogstraal 3 ♂; Ft. McPherson, April 28, 1943 (light trap) ♂. ILLINOIS: Cairo, Eichorn, Giant City State Park, Nr. Mayview, Muncie, Shady Rest and Urbana, Aug. 6–Nov. 8 taken from dried leaves. MICHIGAN: Midland Co., Sept. 15, 1945 R. R. Dreisbach ♀; Roscommon Co., Oct. 27, 1945 R. R. Dreisbach ♀. NEW YORK: Syracuse, Sept. 8, 1933 F. Fletcher ♀; Aurora, Oct. 20, 1945 (dried leaves) K. Sommerman 7 ♂, 28 ♀; Rock City, Sept. 16, 1925 (beating dry leaves) 6 ♀; Ceres, Sept. 16, 1925 (beating dry leaves) ♂, ♀. NORTH CAROLINA: Nautahala Gap (Macon Co.) Oct. 16, 1926 Crosby and Bishop ♀. PENNSYLVANIA: State College, Sept. 15, 1941 S. W. Frost 2 ♀. TENNESSEE: Mt. Le Conte (Mill Creek, below falls) Oct. 10, 1926 Crosby and Bishop 2 ♂. VIRGINIA: Falls Church, Oct. 11 N. Banks ♀.

Lachesilla silvicola Chapman

Lachesilla silvicola Chapman (1930, p. 361). ♂, ♀.

This is a medium-size tan species resembling *arida*. For a complete description of color characters see Chapman, (l. c.).

MALE.—Length of forewings, 1.9–2.3; width of head, 0.5–0.55; length of antennae, 1.5–1.6.

Terminalia: Fig. 6. Sense tubercles brown; paraprocts brown, each bearing a stout posteriorly-directed, bluntly-rounded, mesal prong; suranal plate produced laterally into two light brown, crossed, asymmetrical, twisted hooks; parameres fused at base, distal arms broadly U-shaped; claspers fused to form a single posterior spear-head prong, asymmetrical and directed to the left; hypandrium triangular, fused laterally to basal sclerites of claspers.

FEMALE.—Length of forewings, 2.1–2.2; width of head, 0.6–0.65; length of antennae, 1.3–1.5.

Terminalia: Fig. 25. Sense tubercles brown, paraprocts pale brown; gonapophyses bluntly pointed, postero-mesally-directed, pale, tapering flaps; subgenital plate with a forked flap distally, flap narrower at base than distally and fork extending about one-fourth of length to point of attachment; ventral interior plate external, fused to subgenital plate (the region posterior of base of flap); ventral interior plate colorless.

Holotype ♂, Seattle, Washington, August 7, 1927 C. R. Crosby, PJC.

Records.—CALIFORNIA: Near Hollywood, Dec. 25, 1941 (sweeping grass and shrubs) Sommerman and Hasbrouck ♂; Hemet, Dec. 26, 1938 (in soil) Christenson et al ♂; Ontario, July 27, 1938 (cover grass) Christenson et al ♂; Yuba City, Sept. 19, 1938 (on peach) Christenson et al ♂. COLORADO: Midland, Aug. 8, 1943 (on Limber pine) J. A. and H. H. Ross 2 ♀; Cascade, Aug. 28, 1924 C. R. Crosby 3 ♀. OREGON: Portland, R. P. Currie 3 ♀; Corvallis, April 29, 1931 ♂. WASHINGTON: Longmire, Aug. 22, 1927 C. R. Crosby 2 ♀. WYOMING: Yellowstone National Park (Old Faithful) Aug. 27, 1927 C. R. Crosby ♀. BRITISH COLUMBIA: Kaslo, Jan., 1908 R. P. Currie ♂; University, Oct., 1928 G. J. Spencer 2 ♂.

Lachesilla telsa new species

This is a medium-size, light brown species, closely resembling *pacifica* from which it can be distinguished by cleft of ventral interior plate being posterior instead of anterior.

FEMALE.—Length of forewings, 2.0; width of head, 0.5; length of antennae, 1.1.

Head: Pale, with usual dotted areas on vertex distinct and brown; front brown; ocelli pale with dark inner crescents; ocellar interval pale; clypeus with about twelve mesally-directed light brown bands that almost merge; genae pale, clouded in the middle; antennae, palps and labrum light brown.

Thorax: Dorsum brown paling at sutures; pleura and legs light brown. Wings subhyaline; veins light brown; pterostigma subopaque.

Abdomen: Pale with fuscous markings laterally; terminalia, fig. 24, brown. Sense tubercles light brown on dorsal corner of paraprocts; ventral mesal region of paraprocts swollen and light brown; gonapo-

physes curved mesally, light brown; subgenital plate brown, overlapping bases of gonapophyses; sclerotized portion of ventral interior plate brown, near posterior margin of subgenital plate, with a median triangular non-pigmented area posteriorly; dorsal interior plate transparent.

Holotype ♀, near Hollywood, California, Topanga Canyon, Dec. 25, 1941 (sweeping grass and shrubs) Sommerman and Hasbrouck, KMS. *Paratype* ♀, Vancouver, B. C., University of B. C., October, 1928 G. J. Spencer, CNM.

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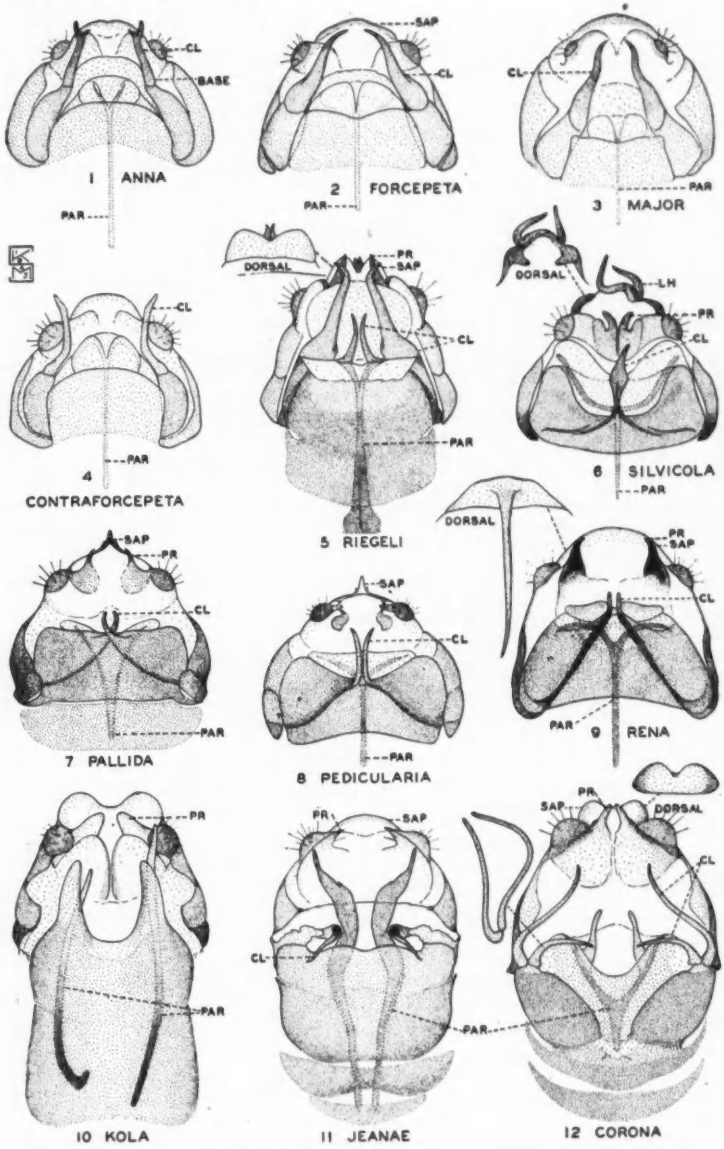
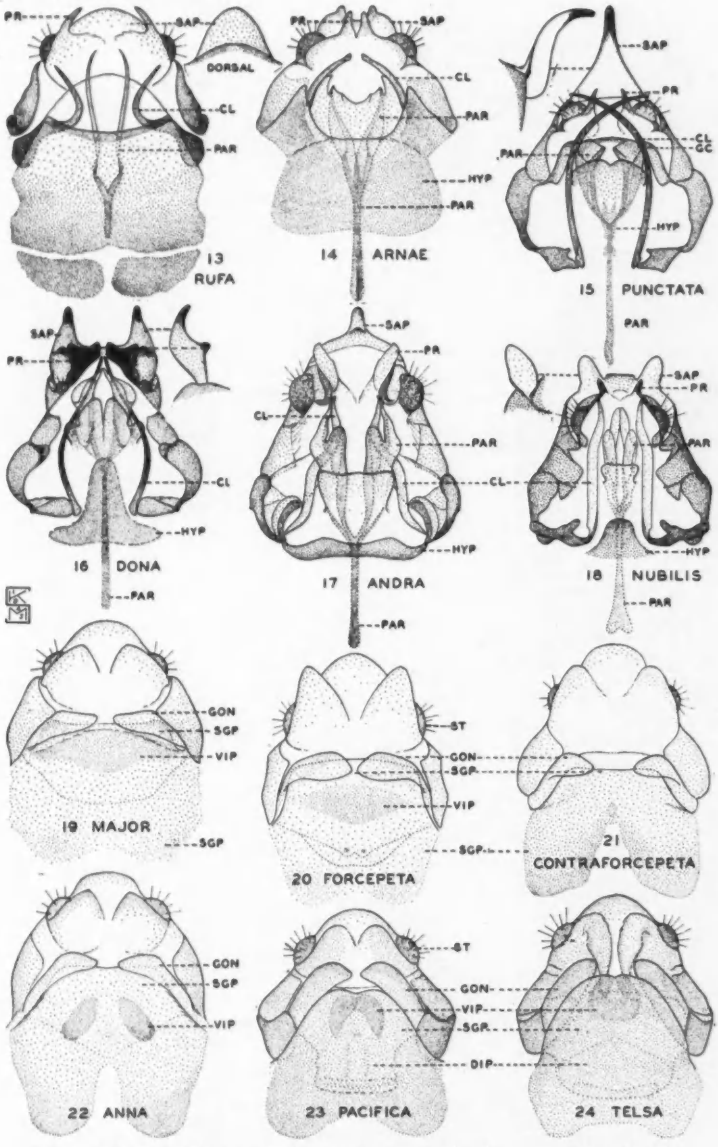
ABBREVIATIONS ON PLATES

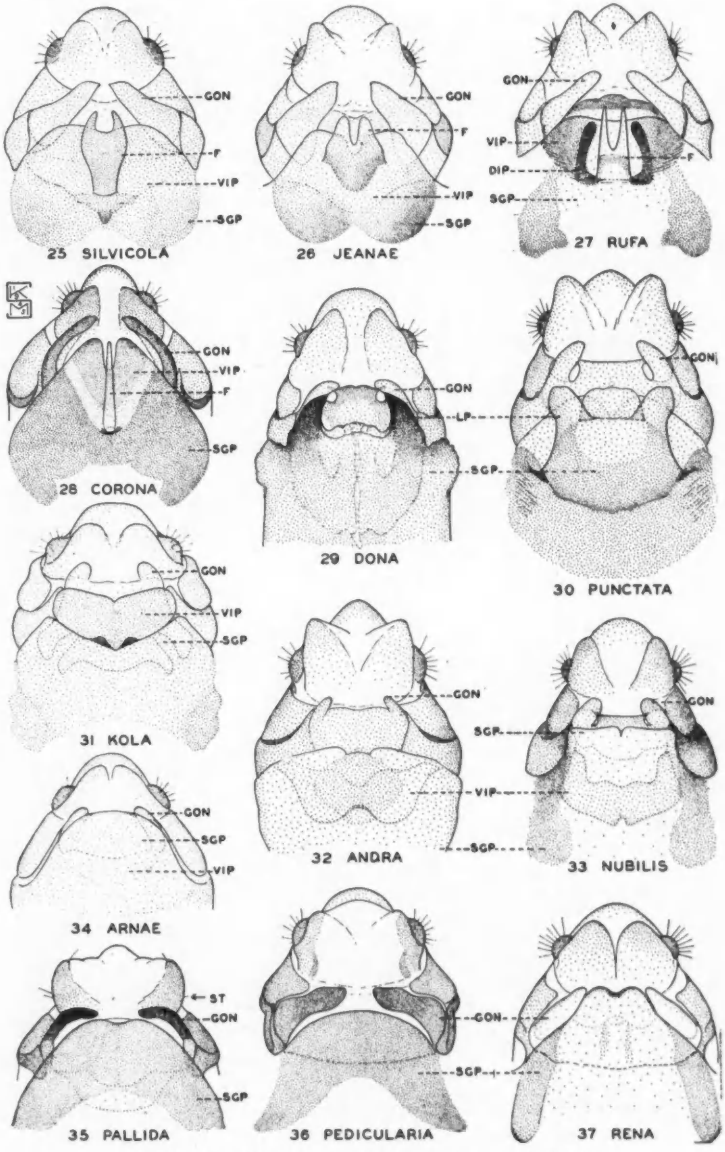
CL—claspers ♂.
DIP—dorsal interior plate ♀.
F—flap ♀.
GC—groove clasp ♂.
GON—gonapophyses ♀.
HYP—hypandrium ♂.
LH—lateral hooks ♂.
LP—lateral projections ♀.
PAR—parameres ♂.
PR—prongs ♂.
SAP—suranal plate ♂ and ♀.
SGP—subgenital plate ♀.
ST—sense tubercles ♂ and ♀.
VIP—ventral interior plate ♀.



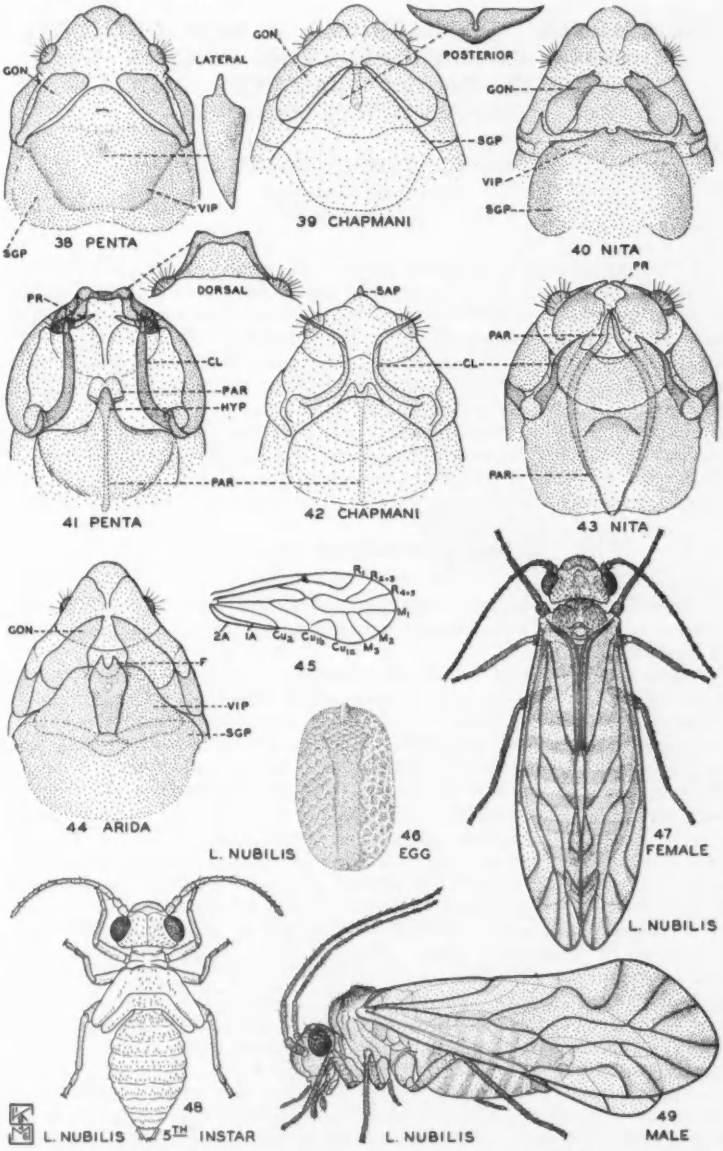
FIGS. 1–12. Male terminalia, postero-ventral view, excepting inserts.



FIGS. 13–18. Male terminalia, postero-ventral view, excepting inserts.
FIGS. 19–24. Female terminalia, postero-ventral view.



FIGS. 25–37. Female terminalia, postero-ventral view.



FIGS 38–40, 44. Female terminalia, postero-ventral view. FIGS. 41–43. Male terminalia, postero-ventral view, excepting inserts. FIG. 45. Right forewing showing venation and terminology. FIG. 46. Egg, dorsal view (not to scale of others). FIG. 47. Adult female, dorsal view. FIG. 48. Fifth instar nymph, dorsal view. FIG. 49. Adult male, lateral view.

EPIGOMPHUS SUBQUADRICES, A NEW DRAGONFLY (ODONATA: GOMPHIDAE) EROM PANAMA, WITH NOTES ON E. QUADRICES AND EUGOMPHUS N. SUBGEN.

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Columbus, Ohio

The species described as new came to the writer in a small collection of dragonflies from Panama mostly collected by Dr. Dale Jenkins, tropical botanist and rubber expert. In the collection was one envelope labeled "Cerro Campana, 2000 ft., Panama Prov., R. P., VIII–10–41, Graham Fairchild." The specimen was completely eaten out by ants or other tropical scavangers and fell to pieces on relaxation. Nothing remains but the hollow exoskeleton.

On examination, the specimen, a male, was found to be closely related to *Epigomphus subsimilis* Calvert, of Costa Rica, and to *quadrices* Calvert, of Guatemala and Panama. We apply the rather awkward compound *subquadrices* to the new species in recognition of this relationship.

Epigomphus subquadrices, n. sp.

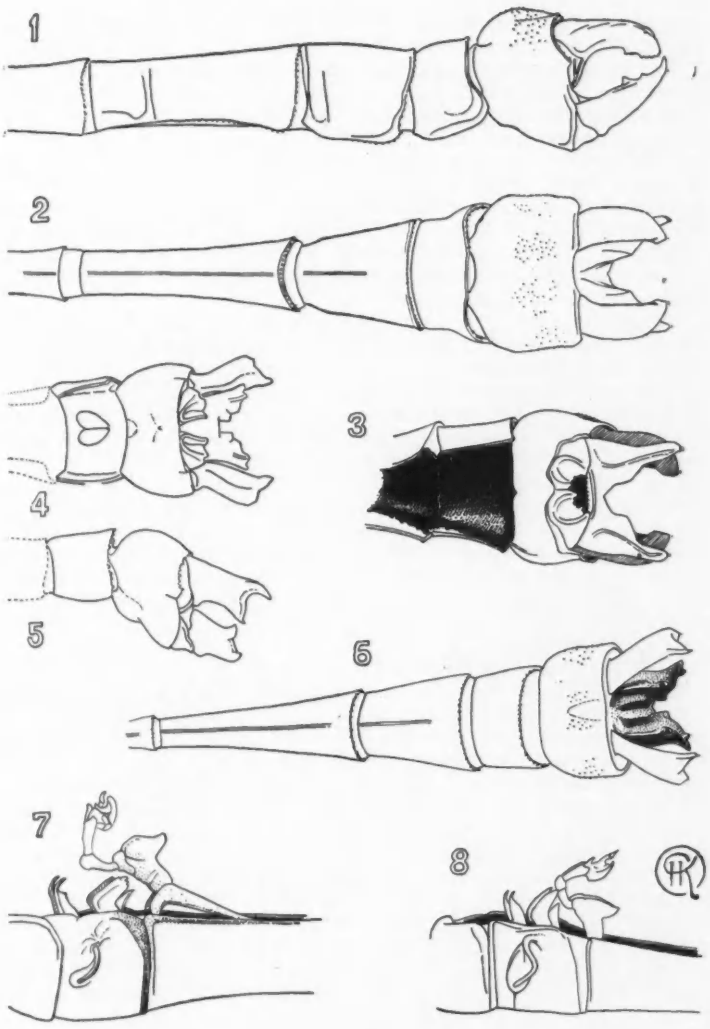
(Figs. 1–3, 7, and 9–13)

Described and figured from the unique holotype in the Kennedy collection. Length of abdomen, including appendages, male, 43 mm.; of hindwing, 36 mm.

Male holotype: Head.—Labrum uniformly dark (brown or black) with a nearly circular yellow spot in each upper outer angle (fig. 11); anteclypeus, postclypeus, frons, vertex and occiput dark (brown or black) except for a pair of oval gray-green spots, barely separated along median line, which cover the anterior two-thirds of the horizontal surface of the frons and whose anterior edges lap down over the upper fifth of the vertical frons surface (fig. 12). Antennae black with pale intersegmental rings. Bases of mandibles yellow but genae slightly darker (gray or pale greenish). Rear of head pale (fig. 10), except the black occipital edge, but with the upper half grayish-green to level of the foramen below which it is pale flavid with mouthparts nearly white.

Prothorax dark with posterior lobe black just in front of which is a cross-row of four pale dots. Proepisternum brownish; coxa pale (yellowish).

Synthorax.—A dark velvety brown, probably black in the living mature insect, the lower sides, venter and coxae pale grayish white (fig. 13). Mid-dorsal keel edged above with a hairline of pale. Each mesoepisternum black with a narrow crossbar below; a diagonal, narrow (width one-twelfth its length) vertical pale green stripe whose lower end is two-fifths of the distance from the middorsal keel to the humeral suture and a triangular dot with rounded angles in the upper posterior angle. Mesinfraepisternum pale but darker above. Side black with a narrow remote posthumeral stripe slightly wider than that on the



FIGS. 1–3 and 7. *Epigomphus subquadrices* n. sp., male.
FIGS. 4–6 and 8. *Epigomphus quadrices* Calv., male, Panama.

episternum and which widens below the alar ridge into a triangle. Lowest fifth of the mesepimeron a sharply defined pale spot. Metepisternum with a pale stripe detached from the second lateral suture. This is broad below enclosing the spiracle and confluent with the pale yellow of the metinfraepisternum which carries a vague cloudy spot. Metepimeron pale with a narrow black stripe along its anterior edge. Legs black with under surfaces of femora shading into pale (greenish). Stigmas of wings dark brown.

Abdomen.—The apical rings in all segments, except on lower side of seg. 1, black. Segs. 1–3 black above with lower two-thirds of sides pale, that on seg. 2 including the pale auricle. Segs. 4–6 as in 1–3, except that all of each segment from the vertical lateral keel to apex is black. Seg. 7 pale (yellow) with apical third black. Segs. 8–10 dark; 8 black, 9 and 10 may be dark reddish brown in life as are the appendages in present state of preservation.

Structural Characters.—The appendages are shown in figs. 1–3. The specimen is so fragile that the appendages could not be spread enough to give a dorsal view of the inferior appendage.

The ventral view of the inferior appendage with its broad, deep median notch with stepped mesal edges of the two prongs distinguishes the species from all other described forms. Added to this, the dorsal surface of the inferior has three nearly equidistant teeth beyond its middle. The superiors are of the heavily tipped type. Fig. 7 of seg. 2 shows that the anterior hamules appear to have had their tips injured (by ants). Fig. 7 shows the decayed sternite of abd. seg. 3 torn out of position. The structure of the penis tip is too badly decayed to figure accurately. The minute apical prong is erectile to twice the length in fig. 7. The auricle on abd. seg. 2 is small and in edge view as shown is crescent-shaped.

Female unknown.

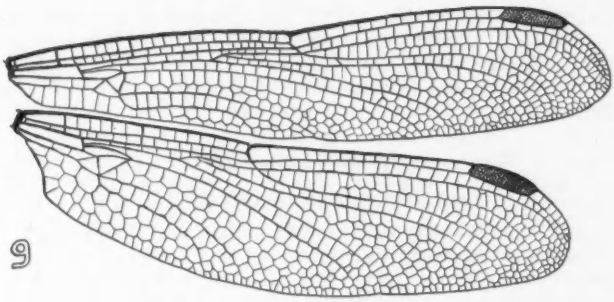
The relationship of subquadrices as judged by male appendages are with *subsimilis* Calvert, 1920, p. 325, pl. XIII, figs. 1–7, and *quadrices* Calvert, (1903), 1920, p. 325, pl. XIII, figs. 8–10. Of the two it is nearer *quadrices* from which it differs in having inferior appendages slightly longer than the superiors. *Subquadrices* differs from both related species in that its inferiors have a simple apex; in the other two a notched apex. See *subquadrices*, figs. 1–3, and *quadrices*, figs. 4–6.

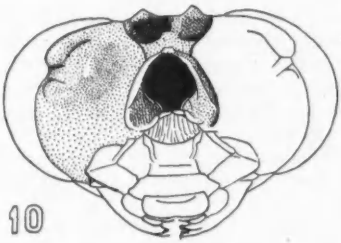
In a letter Professor Calvert, on studying tracings of the author's figures, suggested that *subquadrices* is related to *subobtusus* Selys and *tumifactus* Calv. The author considers these the next closest pair of species to the group, *quadrices*, *subsimilis* and *subquadrices*. The writer's opinion is based on the more elaborate configuration of the inferior appendage of the males of *quadrices*, *subsimilis* and *subquadrices*. On this basis the inferior of *subobtusus* is simple as in *crepidus* while Calvert's fig. 20 (1920) of a dorsal view of the inferior of *tumefactus* does not show as highly developed configuration as that shown in his fig. 8 (1920) for the inferior of *quadrices*. The five species, however, are close and can be variously related on head and color-pattern colors.

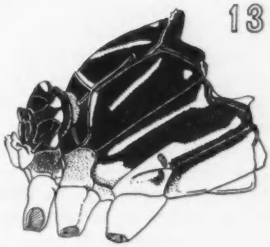
Epigomphus quadrices Calv.

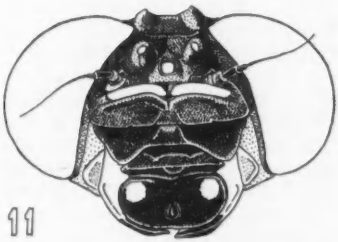
(Figs. 4–6, 8 and 14, 15)

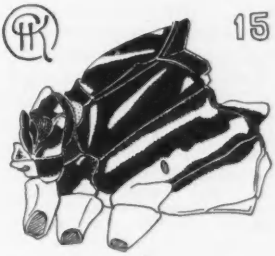
We add to the description of *subquadrices*, n. sp., figures of *quadrices*











FIGS. 9–13. *Epigomphus subquadrices* n. sp., male.
FIGS. 14 and 15. *Epigomphus quadrices* Calv., male, Panama.

Calv. because it is one of the two most closely related species of which we have a short series from Panama. The other close species, *subsimilis* Calv., we have studied only from Calvert's good description but limited figures. We feel this is a proper place for the addition of more figures on Neotropical dragonflies. We need them. See *antea* for further remarks on the relationships of *quadrices*.

Eugomphus, new subgenus

SUBGENERIC GROUPS AND DISTRIBUTION

The genus *Epigomphus* appears to fall into two natural groups morphologically and geographically:

I. *Subgenus Epigomphus:* genotype and subgenotype *paludosus* Selys, 1854, female, the only sex known, "Brazil." This is the typical subgenus with the female *paludosus* the type by the Rules of Nomenclature. This will stand, no matter what the male will be found to be. We associate with it three Andean species: *obtusus* Selys, 1869; Bogota, Col., to eastern Ecuador (Kennedy coll.), Peru and Matto Grosso, Brazil. This is the most widely spread species. Included are *llama* Calv., 1903, Peru and Bolivia; *hylaeus* Ris, 1916, Matto Grosso, Brazil, to Rio Zamora, S. W. Ecuador (Kennedy coll.).

In the three males the group is distinguished by the pointed and narrowly tipped anal superior appendages. See Kennedy, 1936, p. 129, *obtusus*, Ris, 1916, *hylaeus* and *llama*.

II. Subgenus nov. *Eugomphus:* subgenotype, *quadrices* Calv., 1903, Mex. to Panama. Associated with it are: *subobtusus* Selys, 1878, Costa Rica, Guatemala; *tumefactus* Calv., 1903, C. R.; *camelas* Calv., 1905, C. R.; *armatus* Ris, 1916, C. R.; *subsimilis* Calv., 1920, C. R.; *verticornis* Calv., 1920, C. R.; *crepidus* K., 1936, Mex.; and *subquadrices* K., 1946, Panama.

The males of the species of Eugomphus are distinguished by superior anal appendages which are broadly truncate in some or are broadly thickened apically in others.

Eugomphus is northern in distribution, Mexico to Panama (and perhaps into northwest Colombia), while the species of the subgen. Epigomphus are southern, Colombia to Ecuador, Peru and Matto Grosso.

The species *crepidus* in the widely forked and simple appendages of the male appears to be nearest (most primitive) to the generalized species of Gomphus of the Holarctic Realm. It occurs in Nayarit in Sinaloa, Mex., on a possible route from eastern Asia, if it was not differentiated from Gomphus or related stock in North America.

LITERATURE CONSULTED

In addition to that listed in "*Epigomphus crepidus*, a new dragonfly from Nayarit, Mexico, with notes on the genus," Ann. Ent. Soc. Amer., 29: 126–135, 1936, Kennedy, we list:

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Needham, J. G. 1940. Studies on Neotropical Gomphine Dragonflies (Odonata). Trans. Amer. Ent. Soc., 65: 363–394. IV. Venational key to genera of neotropical gomphinae, pp. 387–389. (Key to South American genera.)

Kennedy, C. H. 1925. New genera of Megapodagrioninae, with notes on the subfamily. Bull. Mus. Comp. Zool., 67: 291–311, 1 pl. (Reference to Oriental affinities of Neotropical genera.)

A STUDY OF THE EGGS OF THE PENTATOMIDAE (Hemiptera)[1]

CHARLES O. ESSELBAUGH

For a number of years the writer has been interested in the Pentatomidae, more recently from the standpoint of their bionomics. Further investigation has, as usual, served to emphasize how little we really know about this relatively uneconomic group. This seems to be particularly true concerning the eggs, hence the present effort on the part of the writer to make available such data as he has been able to assemble up to the present. The greater part of the material in this paper constitutes a portion of the writer's thesis presented for the doctorate.

Kirkaldy (1907) is authority for a statement to the effect that the maximum ornateness of eggs is to be found in the Pentatomidae and Reduviidae. Also, it would seem that a close study of the eggs of many a group would be of much importance, if not an absolute necessity, in order to reach any basically sound conclusions regarding the phylogeny of that group, an idea previously expressed by both Reuter (1910) and Schumacher (1917), but which to date does not seem to be much in vogue.

The writer has no illusions as to the state of completion of the present paper. It is strictly preliminary. There are still many genera and even some subfamilies not represented. There are also some intermediate forms, such as *Stiretrus* and *Podops*, whose kinships are uncertain, which need to be studied.

In view of the reputed close relationship between this family and the Scutelleridae, it had been hoped that a comparison of the eggs of the latter could be included in this paper but none have yet been available to the writer for study. Harris and Andre (1934) have figured and briefly described the egg of the scutellerid, *Acantholoma denticulata* Stål. A glance at the figure immediately suggests the difficulty of distinguishing it from the egg of a pentatomid. A ring of 15 or 16 chorionic processes is shown and likewise a hexagonally reticulate chorion is indicated in the text. The egg is more spherical in form than those of most, but not all, Pentatomidae. The indicated color, robin's-egg blue, is also a unique one but is far from likely to be important. The size is well within the limits for pentatomid eggs.

PREVIOUS CONTRIBUTIONS

Perhaps the first significant contribution was that of Korschelt (1887), who discussed the formation of the chorion and its accessories. Heymons (1906) has discussed the egg-burster, having studied it in the European species *Palomena dissimilis* F. A more recent work by Miller (1934) discusses the egg-burster and its variations, illustrated by

[1]Contribution No. 268 of the Department of Entomology, University of Illinois. Acknowledgments for much help and encouragement are due Drs. C. L. Metcalf, W. P. Hayes and W. V. Balduf.

23 figures. Schumacher (1917) has reviewed the literature on the egg-burster and checked its presence in the eggs of a long list of Pentatomidae and Scutelleridae. The latter author points out the interesting fact that this structure was first observed by Harris (1766) in the egg of *Palomena prasina* L., but the egg was mistaken for that of a coccinellid.

One of the principal works of a general nature is that of Heidemann (1911). He has reviewed the works of Leuckart, Korschelt, Heymons and Gross. The work, as it concerns the Pentatomidae at least, is, on the whole, very informative and contains four good illustrations of pentatomid eggs, three of which are unfortunately erroneously determined. In the interest of accuracy it would seem well to make it a matter of record that fig. 1 of his Plate IX is actually *Euschistus* sp. rather than *Thyanta custator;* fig. 2 is in reality *Podisus* sp. instead of *Cosmopepla carnifex* and fig. 4 is *Acrosternum* sp. instead of *Euschistus*. Fig. 3 is *Brochymena* as labelled. The brief general description given for the egg of *Podisus* is correct except for the fact that the length of the chorionic processes has been considerably exaggerated, but his statement concerning the egg of *Cosmopepla* is completely erroneous and really pertains to *Podisus*, which he says it greatly resembles. One of his conclusions concerning phylogeny is of interest. He considers the presence of the egg-burster in the eggs of the Coreidae to indicate a close relationship to the Pentatomidae.

Couturier (1938) has made a very careful anatomical and physiological study of the eggs of *Podisus maculiventris* Say, an American species then being introduced into France to combat the Colorado potato beetle. The eggs of a number of foreign Pentatomidae have been described by Butler (1917, 1922, 1923), Michalk (1935), MacGill (1942) and others.

GENERAL CHARACTERISTICS

Egg Mass.—The eggs of this family are apparently never deposited singly under normal conditions although an unfertilized female, or one which has virtually completed her oviposition, may do so occasionally. The ovipositing female places the eggs on end with more or less care, depending upon the species and apparently to some extent upon the regularity of the substratum. The end upon which the egg stands is the posterior pole of the embryo which is to develop. The eggs are kept in position by an adhesive material, secreted by the female, which fastens them to the substratum and to each other. Strangely enough this material is never placed upon the tops of the eggs, where it might interfere with the hatching process. Bonnemaison (1946) states that this secretion is also the medium for transmission of symbiotic bacteria from the parent to the offspring, the latter taking them up at the time of hatching.

It seems to be agreed by the various observers that the tendency in this group is for the female, when ovipositing upon foliage, to utilize the under side, but two of the predaceous species studied, *Podisus maculiventris* Say and *Perillus bioculatus* Fabr., seem to prefer the more brightly lighted surface, which ever that may be. Stems and fruits, and even flower parts, are frequently used as substrata for oviposition and caged individuals frequently oviposit on the sides and top of the cage.

An exceedingly hairy surface, such as that of ordinary mullein, *Verbascum thapsus* L., is seldom oviposited upon.

Much has been made of the startling regularity of the rows in which the eggs are placed by the female. However, when one considers the manner in which the oviposition is performed, it at once becomes apparent that the rows could scarcely be otherwise than straight, provided the eggs are of uniform diameter, which is nearly always the case. After placing the first two eggs contiguous to each other, the third egg is simply placed in the angle formed by the peripheries of the first two and forced in until it is in contact with both of them. The fourth egg is placed in a similar manner between the second and third. With only slight modification the mass can be formed of two rows or of more, but in any case all the rows are straight. Actually the egg masses of many species are composed of two rows, or sometimes with a partial third, while others typically place the eggs in four or more rows. In some species the form of the mass is adapted to the nature of the space available, being composed of two rows when placed on a small stem or on a fruit of linear form, but in several rows when placed on a leaf blade or other broad surface.

Egg.—The eggs themselves possess several characters which rather readily distinguish them from groups other than the Scutelleridae. The outstanding characteristic most commonly noted by casual observers is the shape of the egg. The eggs of the different species have been designated by various authors as barrel-shaped, cauldron-shaped, drum-shaped, cup-shaped, ovoid and ellipsoidal. These terms are more or less synonymous except the last two, which imply more curvature to the sides as well as the ends, a condition which exists in greater or less degree in about half the species whose eggs have been observed by the present writer. In the other half of the species the eggs greatly resemble a tiny keg, except that the ends are seldom entirely flat. In no case so far observed has the end upon which the egg rests been found to be flat, but this fact usually escapes notice, due to the adhesive in which it stands. The upper end of the egg is in many species decidedly flattened but, with the exception of *Solubea pugnax* Fabr. (fig. 15), is perceptibly convex. MacGill (1942) figures the egg of the European species, *Acanthosoma interstinctum* Linn., as distinctly pointed at the anterior end.

The remaining characters worthy of note have to do with unusual structures, viz., the operculum, egg-burster and chorionic processes, all of which seem to be almost universally present. Chorial spines are also present in some species. The chorion may or may not have other outstanding ornamentation, such as pits, ridges or color.

Operculum.—The operculum is a circular lid comprising essentially the entire upper end of the egg. Its function is to provide an adequate opening for the emergence of the hatching nymph. As the above terminology would seem to indicate, the operculum is actually a distinct unit, separated from the remainder of the chorion by a suture or seam which tends to open when the hatching nymph is forcing its way out. The suture may or may not be discernible before hatching and may even be non-functional, the chorion breaking to one side or the other of it. The initial rupture, however, caused by the egg-burster, seems

to be invariably along the suture but may not continue to follow it. Usually the operculum remains attached by a small arc of its circumference. The usual implication that the operculum is provided with a hinge at this point is probably without foundation in fact, the arc merely remaining intact for the same reason that the end of a tin can hinges when opened by the old-fashioned type of can-opener, viz., lack of tearing action at that point.

Egg-burster.—The egg burster seems to be universal in this family. According to Schumacher (1917) this device also occurs in the eggs of the Scutelleridae and another form of it occurs in the Coreoidea. The above author, and likewise Reuter (1910) considers this and the chorionic processes to be of much significance in phylogeny. The present writer has attempted to illustrate this interesting structure in the drawing of the egg of *Perillus bioculatus* Fabr. (fig. 18). It does not become evident until embryonic development is fairly well completed. At this time, if the chorion is transparent, the egg-burster can be seen as a fuscous or black crescent almost directly beneath the opercular suture, appearing at about the same time as the red eye-spots, which are also located nearly directly under the suture and usually diametrically opposite each other. Both the egg-burster and the eye-spots can be seen to move during the last day or so preceding the hatching of the egg.

It is interesting to note at this point two statements in published literature regarding the opening of the egg. Butler (1923) quotes Muir (without citation) to the effect that "in those species provided with an egg-opener, this instrument actually cuts through the chorion, and does not always cut it along the line of the so-called cap." C. V. Riley (1872), in writing of the egg of the harlequin cabbage bug, states the nymph opens the egg with its beak.

The operation of the egg-burster is quite simple and does not vary in its essentials in the species whose eggs have been examined by the writer. It does not cut. It is composed in part of a rigid material, usually referred to as chitin, and the remainder of three more or less membranous, triangular pieces, each attached on two sides to the rigid part mentioned above. Three rigid arms intersect at their ends to form a very blunt trihedral angle whose vertex is directed upward. The angles between the nearly horizontal arms and the upright, and that between the arms, are occupied by triangular pieces of much less rigid construction. This structure rests upon the dorsum of the unhatched nymph in much the same manner as a yoke used for carrying water pails is carried. The cross arms rest on the anterior margin of the pronotum and the upright extends down the middorsal line. The head of the nymph is deflexed to such an extent that the obtuse angle on the top is enabled to press upward against the extreme edge of the operculum, where it is applied with sufficient force to open the suture at that point. The thin triangular pieces referred to above probably serve to provide a greater amount of surface against which the soft body of the hatching nymph may exert force. The suture is torn open in both directions from the starting point by pulsations of the emerging nymph.

Chorionic processes.—The chorionic processes have been observed

and commented upon by many writers. So far as our knowledge goes, they are universally present on the eggs of Pentatomidae, but on the eggs of some species, like *Murgantia histrionica* Hahn, are so minute as to have escaped notice, or at any rate they never seem to have been mentioned in any of the many descriptions of the egg of this economically important species. In other species, such as members of the genus *Podisus*, they are sufficiently prominent to be visible to the unaided eye.

These processes are always arranged in a circle just outside, and usually below, the opercular suture. They are unarticulated continuations of the chorion. Their form and number vary within rather wide limits within the family but the variations in number within a given species, or even among the eggs of a given mass, is usually nearly as great as within the genus itself, thus precluding the use of this character for separating congeneric species. In the species investigated by the present writer the extremes in number of processes encountered in normal eggs extended all the way from as few as fifteen in *Podisus* to as many as seventy-two, or thereabouts, in *Solubea*. In the latter the processes are practically contiguous.

It seems there has been considerable difference of opinion among various writers concerning the function of these processes. Leuckart (1855) considered them to be a sort of micropyle apparatus, having an opening for the entrance of spermatozoa, but Julius Gross (1901) proposed that these served as an aeration device to substitute for an otherwise impermeable chorion. The latter view seems to be the one currently accepted. Whatever may be their function, it is certain that these appendages are hollow. This was finally demonstrated to the satisfaction of the present writer when some eggs which had just been removed from a vial of alcohol were placed on a watch glass for study under a dissecting microscope. The desk lamp, placed near the eggs, generated sufficient heat to build up some vapor pressure within the eggs, thus forcing fluid out through the lumen of a number of processes and causing it to collect in droplets on their apices. Microscopic examination had also seemed to indicate an opening within, but had been somewhat inconclusive.

In view of the fact that the chorionic processes are considered to perform the function of aeration, it was with considerable interest that the writer observed one egg mass of *Podisus maculiventris* Say in which four of the eggs were abnormal in that the number of chorionic processes was radically reduced. These four eggs had one, two, three and six processes respectively. They were closely watched to see whether the embryos would develop normally but no visible evidence of embryonic development took place. It so happened, however, that several adjoining eggs in the mass, although apparently normal, also failed to develop, so the failure could as well have been due to causes other than insufficient aeration.

Spines.—In addition to the chorionic processes just discussed, the chorion of many pentatomid eggs is also provided with other outgrowths, known in the literature as chorial spines. These differ from the processes in several respects, being of solid construction and pointed rather than knobbed at the apex. In addition to this they are usually

much shorter and, when present, usually occur on all parts of the egg. Although the spines usually cover the entire surface they are frequently much longer on the central portion of the operculum and on the upper half of the side walls.

In most of the spinous eggs so far studied the spines have been accompanied by a peculiar structure of the chorion, the latter seeming to be marked off by fracture-like lines, forming small, angular, closed figures. At each intersection of these fracture-like lines stands a spine. Upon microscopic examination the writer has found that in most species, but not all, this network is formed of a single line of close-set minute spines. Occasionally a few of these latter are also to be found within the cells formed by the network. For the purpose of distinguishing the two types of spines, the larger ones found at the intersections of the network will be designated as primary spines and the minute ones found along the sides and within the cells as secondary spines. In one species, ***Menecles insertus*** Say, only primary spines are to be found and no form of reticulation is to be seen.

Imms (1929) states that in most insects the chorion exhibits some form of external sculpture, being very commonly marked off with hexagonal areas which correspond with the overlying follicular cells which secrete it. There is no mention of spines in relation to this network. About the only possible explanation of the origin of the spines is that they are formed in interstices in the layer of follicular cells, but their uniformly tapered form would seem to contradict this.

The chorion has been described by Korschelt (1887), who states that "the smaller eggs have the texture of the outer surface granulated, while in the larger eggs it is very uneven, covered with polygonal cells, often spinous and tubercular." It is, however, the observation of the present writer that there is little if any relation between the size of the egg and type of sculpturing on the chorion.

In those eggs whose chorion is not spinous it may be smooth and shining or rough and without lustre. In some the chorion apparently has deep pits or punctures, others heavy ridges suggestive of a miniature mountain range. Still others seem to be covered with a vein-like network which may have minute spines coming up from it or may appear to be composed of tiny granules.

In the eggs of most species of Pentatomidae the chorion is transparent, permitting the observer to see the egg contents, but in a few there is sufficient pigment to render it opaque. According to Couturier (1938), in the eggs of ***Podisus maculiventris***, the pigment is not contained in the chorion, but in a serous mantle which covers the entire egg, including the unusually long spines. In this species the color may vary from lustrous pearly to almost black, being influenced, according to the above author, by the food eaten or whether the oviposition took place in light or darkness. In this instance the serous mantle is closely draped over the long spines, and in drying forms a thin, membranous web which extends from spine to spine. The eggs of ***Trichopepla semivittata*** Say have much the same appearance in this respect and the membrane between the spines may well arise in the same manner.

While pentatomid eggs are in most cases white or whitish in appearance, there are also other colors. Seemingly white or whitish eggs

derive their color from the egg contents showing through the chorion. The eggs of colors other than white may derive their color in the same manner but in those of some species there is a pigment, but whether on or in the outer covering has not been determined. In eggs having colored shells, however, the color remaining after hatching is much less intense unless the shell is a black one, as in ***Perillus bioculatus*** Fabr.

Imms (1929) quotes Verson (without citation) to the effect that the chorion of insect eggs is not chitinous, its composition differing from chitin in that it contains sulfur and upwards of 17% nitrogen.

Subfamily **Pentatominae**

Genus **Euschistus** Dallas

The eggs of the species known to the writer are kettle-shaped and nearly white. The chorion is marked off by fracture-like lines which intersect to form triangles and at each intersection is an erect primary spine. The chorionic processes are apparently identical in shape in the eggs of the species studied but there seems to be a somewhat indefinite difference in their numbers, or rather in the range of variation. At hatching there is a tendency in this genus for the chorion to tear below the suture, leaving some of the processes adhering to the lid. The suture is not usually visible before the egg hatches, this being particularly true of preserved material.

Two of the species discussed below have been previously investigated to some extent. Parish (1934) has described the eggs of *E. variolarius*, but the measurements given are exactly half those obtained by the present writer, suggesting a discrepancy in reading the ocular micrometer. There is also some discrepancy as regards the number of processes, the above writer indicating a much smaller variation. Adair (1932) records some observations concerning the egg mass and incubation data on *E. euschistoides* but does not describe the egg itself.

Euschistus variolarius Palisot de Beauvois

Egg mass.—The egg mass is usually placed on the under side of foliage and each individual egg is placed in an upright position. Barring irregularities of the substratum, the eggs are neatly arranged in regular rows, the rows being mostly four in number, or in some cases five. The eggs are cemented to the substratum and to each other by a colorless adhesive secreted by the female at the time of oviposition. The masses ordinarily contain from 14 to 25 eggs, but may contain up to 40. The average is about 18.

Egg (figs. 1, 2, 3).—Length, 1.06–1.13 mm.; diameter, 0.92–0.99 mm. Form somewhat kettle-shaped, slightly larger near base, operculum only slightly convex. Just outside the operculum is a ring of 28–37 somewhat irregularly spaced, clavate chorionic processes, each about 0.07 mm. in length. Color of egg nearly white, some having a slightly greenish tinge when first deposited. Chorion reticulated as indicated for the genus, an acute, erect primary spine arising at the apex of each triangle, these being nearly as long as the processes. When the chorion is viewed under high magnification no reticulation is evident, its course being marked by a few secondary spines.

Euschistus euschistoides Vollenhoven

Egg mass.—The eggs and egg masses of this species do not differ appreciably from those of *E. variolarius*, the preferred place for oviposition being the under side of leaves and the eggs usually arranged in four or more straight rows. The maximum size of the mass, and likewise the average size, is somewhat greater than in the above species, the maximum obtained by the writer being 55 eggs and the average 21.7. Both these figures exceed the corresponding ones for the other two species of *Euschistus* studied.

Egg.—Length, 1.00–1.30 mm.; diameter, 0.92–1.03 mm. Form somewhat kettle-shaped, some of proportionately greater diameter than others. The sides may be straight or slightly curved, greatest diameter sometimes near base. Base usually slightly more convex than operculum. Color white or cream, due to visible contents. Reticulations and spines as in other *Euschistus* species. Chorionic processes 29–38, mostly 33–35. Processes about 0.06 mm. in length, rather narrowly attached at base, form more or less clavate.

Euschistus tristigmus Say.

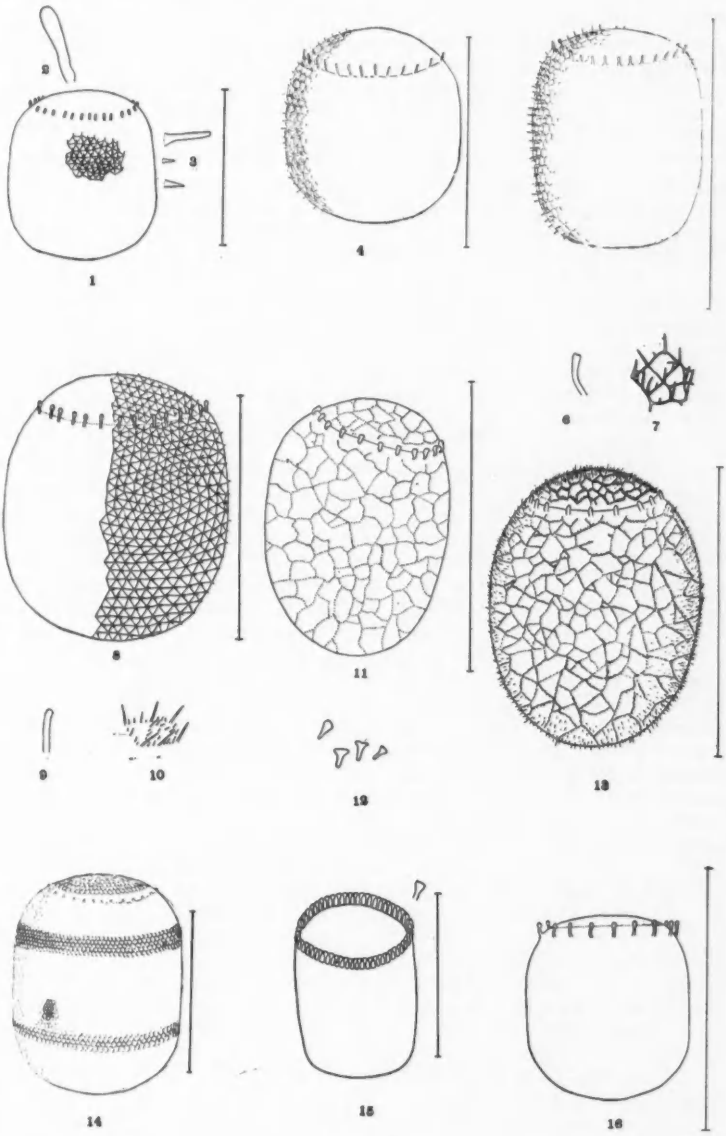
Egg mass.—The egg masses of this species are in general similar to those of the two preceding species but usually consist of fewer eggs, nearly always arranged in four rows. For some reason about 40% of the egg masses of this species consist of 14 eggs, typically two inner rows of 4 eggs each and two outer of 3 eggs each. In confinement the egg masses were placed in such a variety of places that one must hesitate to predict what might be the case in nature but a considerable number were found on the under side of foliage.

Egg.—Length, 0.95–1.00 mm.; diameter, 0.82–0.86 mm. Form somewhat kettle-shaped, varying somewhat in the ratio between length and diameter; base somewhat more convex than operculum, sides nearly straight. White interior shows through transparent chorion, the latter with triangular reticulations; erect, hyaline spines at each apex of the triangles. Chorionic processes whitish, 25–30 in number but most often 27–29. Processes about 0.06 mm. in length, slender at base and only slightly capitate.

EXPLANATION OF PLATE I

Gauge lines alongside drawings indicate 1 mm.

FIG. 1. Egg of *Euschistus variolarius* P. B. FIG. 2. Chorionic process of egg of *E. variolarius*, greatly magnified. FIG. 3. Assortment of chorial spines of egg of *E. variolarius*, greatly magnified. FIG. 4. Egg of *Peribalus limbolarius* Stål. FIG. 5. Egg of *Mormidea lugens* Fabr. FIG. 6. Chorionic process of egg of *M. lugens*, greatly magnified. FIG. 7. Details of chorial spines and reticulation of chorion in *M. lugens*. FIG. 8. Egg of *Coenus delius* Say. Fig. 9. Chorionic process of *C. delius*, greatly magnified. FIG. 10. Details of reticulation of chorion in egg of *C. delius*, showing it to consist of rows of spines. FIG. 11. Egg of *Neottiglossa sulcifrons* Stål. FIG. 12. Details of mushroom-like bodies which replace spines in reticulation of chorion in egg of *N. sulcifrons*. FIG. 13. Egg of *Trichopepla semivittata* Say. FIG. 14. Egg of *Murgantia histrionica* Hahn. FIG. 15. Egg of *Solubea pugnax* Fabr. and detail drawing of single chorionic process. FIG. 16. Egg of *Cosmopepla bimaculata* Thom.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Hymenarcys aequalis Say.

Egg mass. (fig. 29).—The six egg masses secured, all from one female in captivity, ranged in size from 4 to 13 eggs, three masses containing 7 eggs each. These masses consisted of two rows of eggs with the exception of one of the larger masses, in which two eggs were placed in a third row. Five of these masses were attached to the under side of leaves of a corn seedling and the other to the growing tip of a bean stem.

Egg.—Length, 0.70–0.82 mm.; diameter, 0.65–0.70 mm. Form kettle-shaped and more squat than egg of *Mormidea lugens*, which it so closely resembles. Base quite convex, operculum only moderately so; maximum diameter near base, side walls straight or slightly constricted at middle. Chorion hyaline, reticulated, the reticulations consisting of a series of close-set secondary spines, these being longer, more robust, and apparently more numerous, than in *M. lugens*, giving the egg a more spinose appearance; cells almost invariably triangles. Contents of egg remain white during embryonic development. Chorionic processes only slightly dilated at apex, 25–29 in number.

Mormidea lugens Fabricius

Egg mass.—The egg masses of this species are usually rather small and the writer has no record of more than one mass per female. The number of eggs per mass varied from 7 to 20, with most masses containing 10 eggs, which were arranged in either two or three rows. The masses secured by the writer from caged females have for the most part been placed upon the blades and flower panicles of blue grass, but also in a few instances upon foliage of bouncing bet (*Saponaria officinalis* L.) and evening primrose (*Oenothera* sp.).

Egg (figs. 5, 6, 7).—Length, 0.72–0.80 mm.; diameter, 0.60–0.67 mm. Form more or less ellipsoidal, curvature of ends about equal, sides only slightly arcuated, forming a rounded shoulder near ends. Chorion hyaline. Contents of egg white before embryonic development but later showing two roseate longitudinal bands and the entire contents eventually turning the same color. Chorion reticulated with raised lines, a primary spine arising at each intersection and with a few hairlike secondary spines arising from the reticulations and also within the cells. Cells not constant in form, having varying numbers of sides. Chorionic processes rather uniformly 25 in number, only slightly dilated at apex.

Coenus delius Say.

Egg mass.—The egg masses obtained from this species show such inconsistency that it is suspected they do not represent the normal condition. The various masses ranged in size from 1 to 20 eggs, but with half of them of 3 eggs or less. The larger masses show a tendency toward two rows of eggs but these were irregularly and loosely arranged.

Eggs (figs. 8, 9, 10).—Length, 0.92–1.24 mm.; diameter, 0.76–0.99 mm. Form usually ellipsoidal but some may be oval or may have straight sides. Both ends strongly convex. Chorion reticulated with rows of close-set secondary spines, the intersections marked by prominent primary spines. Secondary spines various, but large ones very

common. Secondary spines also common within cells formed by the reticulations. Chorion and accessories usually hyaline but spines, reticulations and processes rarely fuliginous. Processes mostly 26–29 in number, not perceptibly dilated apically (fig. 9). Compared with *Euschistus*, *Coenus* eggs are usually less squat, spines are apparently longer and more numerous.

Peribalus limbolarius Stål.

Egg mass (fig. 36).—Egg masses observed were attached to under side of leaves (red clover), stems and seed pods (*Lepidium campestre*) and most often consist of three rows of eggs or two and a partial third. The largest mass observed contained 28 eggs but, like *Euschistus tristigmus*, there is a pronounced tendency toward masses of 14, seventeen of forty-four masses containing this number. On occasions the eggs within a given mass may vary greatly in size (fig. 36), this variation amounting to 60% or more if based on volume.

Egg (fig. 4).—Length, 0.85–0.99 mm.; diameter, 0.67–0.81 mm. Form variable and frequently irregular. Length usually about 1.25 times the diameter. Base usually more convex than operculum. Color when freshly deposited bright lavender but becoming a beautiful old rose upon drying. Empty shells pale salmon. Reticulation present, most readily observed in hatched eggs. Chorionic processes small, clavate, paler in color than remainder of chorion, the number varying from 15 to 21 but 16 to 19 most frequent. Spines have somewhat the appearance of blond whiskers, the tips showing against the darker background as pinpoints of light color.

Menecles insertus Say.

Egg mass.—No information whatsoever concerning any of the immature stages of this species is to be found in the literature. The following information is based upon three masses of eggs oviposited by a single female. These three masses consisted of 13, 11 and 10 eggs. The masses were inclined to be irregular and some of the eggs were placed on their sides instead of in the customary upright position. These eggs were attaced to a leaf of *Polygonum* sp.; where they would be found in nature seems to be anybody's guess.

Egg (fig. 27).—Length, 1.38–1.48 mm.; diameter, 1.06–1.16 mm. Color white, due to egg contents showing through chorion. Form somewhat ovoid, side walls curved, but usually not with same curvature on the two sides of the egg. Greatest diameter somewhat nearer the top, curvature of ends about equal, quite convex. Chorionic processes about 30, small and inconspicuous, irregularly clavate. Chorial spines present, ranging from pyramidal to almost setose, forming an irregular network but without the reticulated appearance observed in the species described heretofore.

Trichopepla semivittata Say.

Egg mass.—Caged individuals have in general refused to oviposit upon such food material as was provided, utilizing instead the wire screen of the cage or the disc of paper towel on the floor of the cage.

Those attached to the paper floor of the cage were all attached to the lower surface, which might indicate a similar habit on foliage. Blatchley (1926) reports taking it in all stages on *Eryngium yuccifolium*.

The egg masses are most commonly made up of three rows with frequently one or two eggs starting another row. The tendency toward precisely 14 eggs per mass is most pronounced in this species, such being the case in exactly two-thirds of the 21 masses examined. In the remaining masses the number of eggs ranged from 11 to 28.

Egg (fig. 13).—Length, 0.88–0.93 mm.; diameter, 0.67–0.70 mm. Form somewhat ellipsoid, ends strongly convex, sides nearly or quite straight for a short distance near middle. Chorion translucent gray with reticulations consisting of castaneous to fuliginous spines webbed together by membrane of same color. Chorionic processes 15 to 20 in number, but mostly 16 to 18, white apically, not dilated at apex. Operculum usually somewhat askew. No spines or reticulations about margin of operculum or between opercular suture and chorionic processes. Opercular suture readily discernible.

Neottiglossa sulcifrons Stål.

Egg mass (fig. 35).—The eggs obtained from caged individuals have been found in various situations, including foliage and on the glumes of grasses, but most frequently upon the slender branches of blue-grass panicles. In the latter situations the mass invariable consists of two regular rows of eggs, but when deposited upon the glumes and foliage the masses show a decided tendency toward several rows and also increased irregularity in arrangement. The masses so far observed ranged in size from 2 to 14 eggs but for the most part from 7 to 12. The larger masses nearly always have one or more eggs in a prostrate position.

Egg (figs. 11, 12).—Length, 0.83–0.92 mm.; diameter, 0.56–0.60 mm. Form elongate oval, ends quite convex. Color cream to dirty white with somewhat translucent reticulations, consisting of small, irregular areas fenced off by what appear to be single, wavering rows of angular granules but are actually the greatly dilated ends of mushroom-like outgrowths. Chorion nearly hyaline but becoming somewhat yellowed in preserved specimens. Chorionic processes very minute, apparently about 20 in number.

Neottiglossa cavifrons Stål.

Egg mass.—Only two egg masses have so far been obtained from this species and the observations given below are therefore based upon

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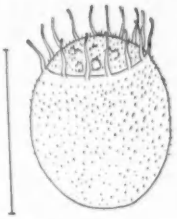
EXPLANATION OF PLATE II

FIG. 17. Egg of *Podisus maculiventris* Say. FIG. 18. Egg of *Perillus bioculatus* Fabr. in hatched condition, showing egg-burster hanging on lip of opercular opening. FIG. 19. Egg of *Apateticus* sp. FIG. 20. Egg of *Acrosternum hilare* Say. FIG. 21. Chorionic process of egg of *A. hilare*, greatly magnified. FIG. 22. Detail drawing of pits in chorion of egg of *A. hilare*, greatly magnified. FIG. 23. Egg of *Brochymena* sp. FIG. 24. Chorionic process of egg of *Brachymena* sp., greatly magnified. FIG. 25. Egg of *Thyanta custator* Fabr., showing pits and color bands. FIG. 26. Egg of *Chlorochroa persimilis* Horv. FIG. 27. Egg of *Menecles insertus* Say.



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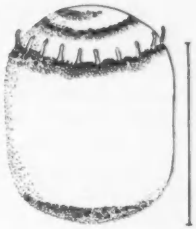

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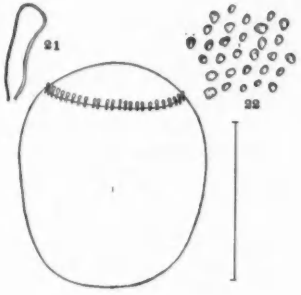

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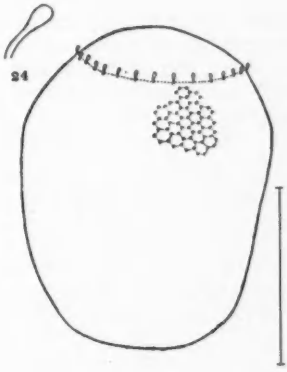

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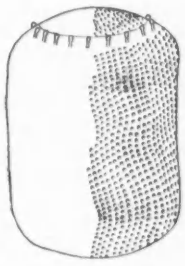

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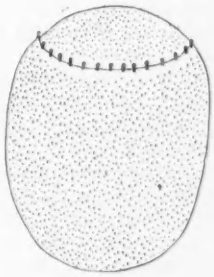

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very limited material. The above masses were both deposited upon blue-grass and differed in no respect from those of the above species. These two masses were each composed of two straight, compact, interlocking rows and consisted of 10 and 11 eggs respectively. One was attached rather insecurely to the side of the glumes of the blue-grass and the other to one of the slender branches of the panicle, the bases of the eggs in this latter mass being laterally attached to the stem.

Egg.—Measurements were made with a less accurate measuring device than used heretofore but the eggs, by comparison seemed to be equal in size to those of *N. sulcifrons*. Length, 0.80 mm.; diameter, 0.54 mm. No visible difference from the above were noted except that the color was roseate during the first two or three days following oviposition.

Genus **Chlorochroa** Stål

The writer has had only one species, *Chlorochroa persimilis* Horv., available for study. There is, however, literature treating of two other species, both of some economic importance. In order to get this information together, pertinent parts of the descriptions of these two species will be included in this paper.

Chlorochroa persimilis Horvath.

Egg mass (fig. 28).—The eggs of this species have not been found in the field by the present writer, although a search was made on the food plant itself (*Opuntia*) and on nearby weeds and grasses. Confined females deposited their egg masses on various parts of the cage and less frequently upon the *Opuntia* fruits which had been provided as food. The egg masses of this species do not seem to follow any definite pattern but most often contain about four rows of eggs. While the rows are reasonably straight, the eggs are somewhat less compactly arranged than in most species. The maximum number of eggs per mass was 43 and the average 21.3.

Egg (fig. 26.—Length, 1.35–1.55 mm.; diameter, 1.05–1.25 mm. Form subcylindrical, usually slightly constricted at middle, bottom end rounded off, usually asymmetrically so. Greatest diameter attained a short distance below ring of chorionic processes. Side walls and base of egg shining ivory white, with deep, concolorous punctures. Surrounded by this ivory white, and usually in the form of a broad band about the egg, is a sunken blotch or blemish of sepia brown, which may be either impunctate or very shallowly punctate. Sepia area may contain an irregular blotch of punctured white like the surrounding area. Just above the upper shoulder of the egg, and extending to just below the ring of chorionic processes, is a ring of bluish gray with deep, concolorous punctures and usually considerably broader on one side of the egg than on the other. Just above this ring is a narrower ring of snowy white, flaky appearance covering opercular suture and containing in its outer edge the ring of 25 to 30 chorionic processes; this ring of white is usually slightly elevated. Chorionic processes are short, white, clavate. Inside this ring, on operculum, is another ring of bluish gray then another of shining ivory white, which in turn has a bluish

gray center. Smaller ring and center spot irregular, center spot impunctate. Bluish gray portions change to sepia during embryonic development. In empty shells, portions formerly sepia or gray become transparent; white portions become milky, translucent.

Chlorochroa sayi Stål.

According to Patton and Mail (1935), most egg masses were found on old wheat stubble, but also on Russian thistle where latter predominated. The egg masses deposited on old wheat stubble were usually arranged in two rows and contained 14 to 35 eggs but on larger surfaces the masses were found to be more or less shapeless. A half-tone illustration of an egg mass is included in the above paper.

Caffrey and Barber (1919) also studied what is supposedly the same species as the above but, in view of certain rather glaring discrepancies, this is open to some doubt. It is in the latter publication that the description of the egg is found.

Egg.—Length, 1.1–1.2 mm.; diameter (maximum), 0.88–0.93 mm.; diameter at bottom, 0.57–0.66 mm. The egg is irregularly ovoid in form, with irregular gray areas on the lateral surface, in appearance resembling froth. Viewed from above, three white circles appear, inclosing a central dull-gray area and two circular bands of the same color.

Chlorochroa ligata Say.

The bulk of the work on this species has been done by A. W. Morrill, no less than four papers by this author being at hand. It is from these papers, principally that of 1910, that the following data have been taken.

Egg mass.—The egg masses are apparently deposited on various parts of the food plant, at least this seems to be true on cotton. The maximum number of eggs recorded per mass is 79 and the average 28.4. The above writer calls attention to the frequency with which eggs are deposited in multiples of 14, 28 being the most frequent and 42 next. No information is given as to the form of the mass but, judging from the number of eggs, there are likely several rows.

Egg (from Morrill, 1905, 1910). Diameter about .9 mm. and height about 1.2 mm. There are three distinct parts of the egg which may be termed body or lower part, neck or intermediate part, and the lid or cap. The last named portion usually remains attached by a hinge after the hatching of the young. The body, height of which is about two-thirds that of the entire egg, is subcylindrical, being constricted in the middle, rounded more or less at the lower end, and at the upper abruptly curving inward to meet the neck. The width of the neck on the side (dorsal) opposite the hinge of the cap is about one-sixth of the entire height of the egg, and on the ventral side about one-third as wide as on the dorsal side. On the upper margin of the neck are pure white blunt processes, numbering as a rule 22. The cap is subconical, diameter at base two-thirds of diameter of body of egg, height one-fourth or one-fifth the diameter of base, apex rounded or somewhat flattened. The appearance of the egg is affected by translucent and opaque areas, which seem to be due to the absence and presence of a

coating of wax. The cap is translucent, except for the edge, and the neck is translucent, except for its upper edge adjoining the cap, the translucent areas are quite dark. In some of the empty shells of the same batch of eggs the translucent areas remain clear, though not transparent, and in some they become yellowish. The entire chorion is closely and finely punctate, the punctures in the transparent parts being smaller than on the opaque parts.

Thyanta custator Fabricius

Egg mass (fig. 34).—The egg masses of this species usually consist of four to eight straight rows of eggs securely fastened together and to the substratum. The maximum number of eggs observed per mass was 72 and the average for 50 masses was 35.4. What surface is chosen for oviposition in nature has not been determined; confined females usually utilize the sides of the cage.

Egg (fig. 25).—Length, 0.94–0.98 mm.; diameter, 0.74–0.77 mm. Form cylindrical with convex ends, latter having approximately equal curvature. Chorion somewhat calcareous in appearance, two-tone gray or buff in color, side walls of the lighter shade except for two rather irregular bands near top and bottom, operculum of darker shade with rounded spot of paler shade in center. Chorion with rounded pits, not transparent; chorionic processes small, 18 to 22 in number, slightly capitate.

Acrosternum hilare Say.

Egg mass.—The place chosen for oviposition varies considerably for this species. According to Underhill (1934), if the host plant has flat fruit pods, most of the masses are placed there, otherwise the great majority are placed upon foliage, with apparently little preference for either surface.

The egg masses of this species sometimes attain considerable proportions, the maximum secured by the writer in rearing being 69, which is appreciably larger than that obtained by Whitmarsh (1917), Underhill (1934) or Sorenson and Anthon (1936), all of whom have worked with this species. The average size of the mass is, however, only about half this figure. It seems to be the general rule that the first mass deposited by a female is the largest, the others gradually diminishing in size.

The form of the egg mass in this species is less definite than in most pentatomid species. The eggs are placed on end and in several fairly

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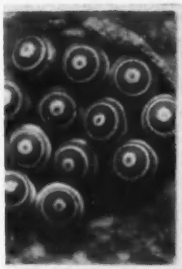
EXPLANATION OF PLATE III

FIG. 28. Portion of egg mass of *Chlorochroa persimilis* Horv. FIG. 29. Egg mass of *Hymenarcys aequalis* Say. FIG. 30. Egg mass of *Cosmopepla bimaculata* Thom. about to hatch, egg-burster and eye-spots showing through operculum. FIG. 31. Egg mass of *Brochymena* sp. clustered about stem of *Laportea canadensis* Linn. FIG. 32. Portion of egg mass of *Podisus maculiventris* Say deposited upon wire screen. FIG. 33. Egg mass of *Solubea pugnax* Fabr. on leaf of *Geum lacinialum* Murr. FIG. 34. Egg mass of *Thyanta custator* Fabr. on wire screen. FIG. 35. Egg mass of *Neottiglossa sulcifrons* Stål on seed pod of *Lepidium campestre* (L.) R. Br. FIG. 36. Egg mass of *Peribalus limbolarius* Stål, showing variation in size of eggs.



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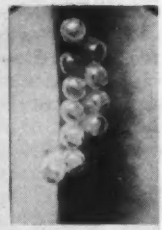

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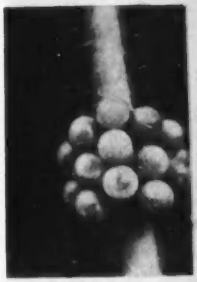

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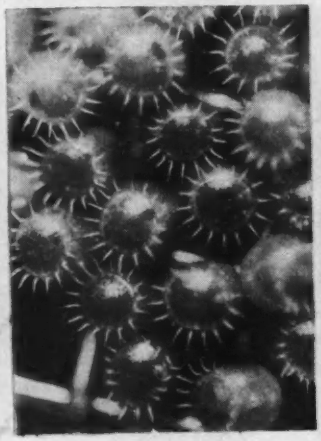

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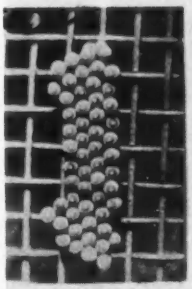

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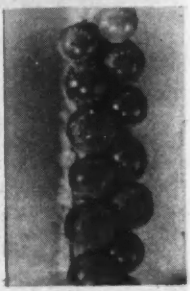

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definite rows, but the adjacent rows are not usually tightly interlocked as in most species.

It is interesting to note that the eggs may be either lemon yellow or yellowish green in color, but all eggs within a given mass are the same color. According to Whitmarsh (1917), the color is peculiar to the particular female, but Underhill (1934) states that under field conditions about 85% of the masses are of the green variety, while under laboratory conditions fully 50% show some yellow.

Egg (figs. 20, 21, 22).—Length, 1.40–1.50 mm.; diameter, 1.20–1.25 mm. Form somewhat cup-shaped, sides may be slightly arcuated or straight at middle, usually with a perceptible shoulder a short distance from margin of operculum. Operculum moderately convex, base more strongly so but blending into side walls without forming a shoulder. Chorion hyaline, contents showing through, varying in color from lemon yellow to pea green in newly deposited eggs. During embryonic development, the yellow eggs become roseate and the green ones cinereous. Chorion with definite, but somewhat wavering, rows of angular punctures. Chorionic processes 45 to 65 in number, rather strongly clavate (fig. 21), leaving egg at right angles, then turning abruptly upward. Opercular suture plainly visible.

Murgantia histrionica Hahn

Egg mass.—Only one egg mass of this species has been available for study, this consisting of two rows of eggs, which is indicated in published literature to be the regular condition. The masses are said to consist of about 12 eggs each and attached to the under side of the leaves of the host plant, which is in most cases one of the Cruciferae.

Egg (fig. 14).—Length, 1.30–1.38 mm.; diameter, 0.90–0.92 mm. Form cylindrical, giving rise of pronounced shoulders at the ends. Ends somewhat flattened, of approximately equal curvature. Eggs marked by two fuscous transverse bands on side wall and a crescent of same color on margin of operculum. Upper band located immediately below upper shoulder and is half again as broad as lower band. One rounded fuscous spot midway between bands. Crescent on operculum of about same width as upper band and tends to be located on side most remote from adjoining eggs of the mass. Remainder of egg surface, including lower end, whitish. Entire chorion has very finely reticulated or cellular appearance, this latter seeming to extend to some depth. Processes extremely minute, about 30 in number.

Cosmopepla bimaculata Thomas

Egg mass (fig. 30).—The egg mass may be attached to any of various surfaces, such as the foliage or stem of the plant. Unlike other species so far investigated, this one did not hesitate to oviposit freely on such hairy surfaces as that provided by common mullein, *Verbascum thapsus*. In the case of this species oviposition is recorded by two previous writers. Olsen (1910) has bred them from egg to adult upon moth mullein, *Verbascum blattaria* L., but it is to be assumed that this was in confinement. Balduf (1926) found them ovipositing upon cultivated snapdragon. Olsen (loc. cit.) says they oviposit on any part of the plant.

The egg masses obtained by the writer have varied from 2 to 24 eggs, which is a higher maximum than that reported by the above authors. The average of the various masses has been about 11 eggs.

The arrangement of the eggs in the mass varies considerably, those deposited on stems usually consisting of two rows with sometimes a partial third, those on foliage and other broad surfaces being inclined to lack definite form.

Egg (fig. 16).—Length, 0.74–0.85 mm.; diameter, 0.55–0.71 mm. Form kettle-shaped, varying somewhat in degree of elongation. Color varies from pale greenish-yellow to deep golden yellow and is due to contents, the chorion being entirely hyaline, shiny, devoid of spines or sculpturing. Operculum somewhat less convex than base. Chorionic processes of moderate size, strongly capitate, 15 to 22 in number.

Solubea pugnax Fabricius

Egg mass (fig. 33).—This species is probably not very specific as to the plant upon which it oviposits. Garman (1891) states that it oviposits upon *Setaria* and *Panicum*, and Douglas (1939) reports oviposition on stems, leaves and panicles of rice. In confinement it oviposited upon practically anything offered. The masses varied in size from 8 to 44, consisting of two rows of eggs.

Egg (fig. 15).—Length, 0.86 mm.; diameter, 0.65 mm. Form cylindrical except for being rounded off at base. Full diameter carried to edge of operculum, forming a decided corner, from which the chorionic processes arise. Processes white, decidedly clavate, 67 to 72 in number, contiguous. Head of each process comprises about half its length and has a diameter about three times that of stem. Color of egg apple green, due to visible contents but red markings appear as embryo develops. Red marking on operculum takes the form of the letter "W." Chorion devoid of spines but under high magnification can be seen to be sculptured with sparse, tiny elevations arranged in irregular, transverse, undulating rows which do not intersect.

Brochymena sp.

Egg mass (fig. 31).—The writer found a mass of 14 eggs clustered around a stem of the woods nettle, *Laportea canadensis* L. in a tract of University woodland. Lacking further material from caged individuals, it was necessary to depend upon other sources for identification. Fortunately some of Hart's (1919) material was still available in the collection of the Illinois State Natural History Survey, definitely establishing it as belonging to *Brochymena* sp. Unlike any other egg mass of this family seen by the writer, this particular one completely surrounded the stem. Blatchley (1926) has recorded an already hatching mass of eggs of *B. quadripustulata* Fabr. on the under side of a leaf of skullcap, *Scutellaria nervosa* Pursh. His description of the eggs, however, lacks sufficient detail to make determination possible. Since the genus is an arboreal one, these two instances of oviposition on herbaceous plants might seem rather out of character, but the writer has also taken even the smallest nymphs from vegetation growing beneath trees. At any rate no other oviposition records for this genus seem to be available.

Egg (figs. 23, 24).—Length, 1.8 mm.; diameter, 1.3 mm. Maximum diameter attained at a point near top of egg, making a rather abrupt shoulder. Chorionic processes about 27 in number and distinctly capitate (fig. 24), minute compared to size of egg. Chorion hyaline, egg translucent gray in color. Sculpturing consists of pits or punctures in hexagonal arrangement but not connected by any visible reticulations. Opercular suture well defined, bordered outside by thin impunctate ring.

Subfamily **Asopinae**

Podisus maculiventris Say.

Egg mass (fig. 32).—The arrangement of eggs in the mass is not nearly so precise in this species as in most of the phytophagous species studied but they are still arranged in fairly definite rows, although not so closely spaced. The number of rows of eggs in the mass is usually about four. In further contrast to the phytophagous species, this one usually deposits upon the upper side of foliage, unless the lower one happens to be more strongly lighted. Under rearing conditions the masses are more often found on some part of the cage. The egg masses of this species are of moderate size, the maximum number of eggs per mass observed was 57 and the average 25.

Egg (fig. 17).—Length, 0.95–1.05 mm.; diameter, 0.86–0.93 mm. Form subglobose to oval, operculum slightly more flattened than base. Color of chorion varies from pale yellow to gunmetal, except the spines, which are usually fuscous to black. Spines on operculum longer, forming a reticulum and more or less connected by a dark, foliaceous membrane which sags considerably between spines. Margin of operculum and top of side wall marked by a laevigate ring, from the lower margin of which arises the circle of chorionic processes. Processes usually 15 to 17 in number, about one-fourth as long as the egg itself, once sinuated, capitate, and with slender neck just below the terminal knob. Chorial spines on lower portion of egg shorter than those above.

Perillus bioculatus Fabricius

Egg mass.—The oviposition habits are similar to those of *Podisus maculiventris*, the egg mass being usually deposited in some exposed location. In the field the eggs are usually deposited upon the upper surface of a potato leaf or on the rachis, but in the laboratory they are deposited in as many cases on the sides of the cage or on a piece of cloth or paper hung in the cage for that purpose, the latter being a device used by Couturier (1938) in rearing the preceding species.

In the limited rearing work carried on by the present writer, the masses consisted of 7 to 32 eggs, the average being about 16, but with no tendency toward any particular number. Knight (1922) indicates that normally the mass consists of two fairly straight rows but the present writer did not find this to be the case except when deposited upon a narrow surface, such as the petiole or rachis of the potato leaf.

Egg (fig. 18).—Length, 1.05–1.20 mm.; diameter, 0.77–0.95 mm. Form varies, but most often is somewhat elongate with greatest diameter above middle and forming a truncated cone above shoulder. Cho-

rion generally piceous but may be diluted to blackish or fuscous, or rarely golden yellow; coarse ridges of same color as remainder of chorion stand out in irregular relief on upper half of egg, diminishing gradually to irregular, evanescent rows of short, pyramidal spines. Operculum with raised ring of same appearance as ridges on upper half of egg. In transparent specimens this can be seen as a ring of spines covered with a serous secretion. Chorionic processes broadly attached to chorion, curving upward and having a small apical knob, preceded by a short slender neck, concolorous with chorion and 12 to 18 in number, usually 13 or 14.

Genus **Apateticus** Dallas

The eggs described below are unfortunately not associated with the adult stage of the species, making it necessary to rely solely upon circumstantial evidence for determination. The first and principal clue to their identity is the fact that the mass was collected in the dead of winter. The eggs are very evidently those of a pentatomid and the only record of overwintering eggs in this family pertained to the above genus (Downes 1920, Stone 1939). Stone gives no description of the eggs of *A. cynicus* Say, from which he did some subsequent rearing and Downes gives only a brief general description of the eggs of *A. crocatus* Uhl. but such material as is available is at least not contradictory to the above tentative determination. The species here under consideration is most likely *A. cynicus* Say. Incidentally, the egg mass figured in Parshley (1923), Plate XIX, fig. 7, as *Podisus* sp. is in all likelihood a species of *Apateticus*, at any rate it certainly is not *Podisus*.

Egg mass.—The mass referred to above consisted of two rows of eggs set, in the usual compact manner, on a twig which seemed to be from an apple tree. The number of eggs in this mass is not now known to the writer, but was rather large, probably about 40.

Egg (fig. 19).—Length, 1.25–1.35 mm.; oval in cross section, diameters approximately 1.10x1.20 mm. Form, in lateral view, approximately ellipsoidal but with a rather abrupt shoulder just below the ring of chorionic processes. Color (preserved specimens) pale yellowish, with basal end of egg, a band beneath ring of chorionic processes and two concentric rings on operculum fuscous. Surface of chorion with contiguous, large shallow depressions, giving a finish resembling that of hammered brass. Chorionic processes about 16 to 18 in number, broadly and perpendicularly attached at base, but immediately bending in such a manner that the processes follow parallel to curvature of operculum. Points of attachment of processes located along upper margin of the fuscous band and apices reach outer margin of larger fuscous ring on operculum; apices of processes not dilated.

NOTES ON PHYLOGENY

As regards the determination of the phylogeny, it soon becomes apparent that the material at hand is inadequate. Whether the study of other existent forms will serve the purpose is yet to be seen; some of the fundamental links may already be extinct.

The question arises as to whether the evolution of the eggs need

necessarily be in line with that of the other stages. It seems possible that the species showing the most specialization, as judged by the adult, may have one of the more generalized eggs. The egg could well be a holdover from some ancestral form or it could, on the other hand, represent all or most of the evolutionary changes which the species has undergone. It seems, however, that the evidence furnished by a study of the eggs cannot be ignored when the phylogeny is to be determined.

As regards the separation into subfamilies, little material is yet at hand, the only such groups concerned in the present study being the Asopinae and the Pentatominae. The only common points of difference noted between these groups is in regard to the chorionic processes, these showing a tendency toward smaller numbers and greater development in the Asopinae. In the instances so far noted the processes in this group are broadly and strongly attached at the base and the insertion is approximately perpendicular to the curvature of the egg, the processes then being bent abruptly upward and following approximately the curvature of the operculum for at least a part of their length. To what extent this character will hold in other genera of this subfamily can only be conjectured, but has been found to be true for members of the three genera included in this paper and is further supported by published illustrations of *Zicrona caerulea* Linn. (Kershaw & Kirkaldy, 1909) and *Oechalia grisea* Burm. (Kirkaldy, 1907).

The bulk of the material in the present paper concerns species included in the tribe Pentatomini. The diversity of character of these species is so great as to indicate further subdivision may be in order.

The generic arrangement in this tribe in the various works seems generally to follow that in Van Duzee's catalogue, which in turn is based on Reuter's classification, but if it is intended to represent even an approximation of phylogenetic relationships, there is sufficient material provided here to offer some strong contradictions. The Van Duzee arrangement seemingly cannot possibly represent relationships. The sequence *Peribalus*, *Trichopepla*, *Chlorochroa*, *Mormidea* and *Solubea* seems to have no significance whatsoever from the standpoint of egg types, only *Peribalus* and *Mormidea* having anything in common. Further down the list we find the genera *Hymenarcys*, *Neottiglossa*, *Cosmopepla*, *Menecles* and *Thyanta* in that order but with a few other genera sandwiched between. These have no closer relationship to each other than do those of the earlier sequence, but two represent a repetition of types found above. Blatchley (1926), on the other hand, has divided the Pentatomini into three subtribes, a scheme which seems to be much more in line with the present findings. *Chlorochroa* and *Thyanta*, whose eggs are very similar, fall into the same subtribe but along with *Peribalus* and *Trichopepla*, which do not seem to belong with them or with each other. The genera *Mormidea*, *Euschistus*, *Hymenarcys* and *Coenus* are also brought together, which is proper, but are accompanied by extraneous material.

In attempting to determine the primitive type of egg we are again hindered by limitations of material. If we consider the larger number of chorionic processes as being an indication of a more primitive condition, *Solubea* and *Acrosternum* head the list, having about twice as

many processes as most of the others, but it also indicates the Asopinae as being the most specialized, a premise which is not generally accepted.

It would perhaps be well to discuss briefly in this connection a few of the characters which the eggs of certain genera have in common. One such is the presence of pits in the chorion, which are to be found in *Chlorochroa*, *Thyanta*, *Acrosternum* and *Brochymena*. Of these the first two genera seem to be definitely related, the pits being similar and the evidence is further supported by pigmentation in the chorion itself and other points of similarity, but *Acrosternum* and *Brochymena* do not seem to belong in this category. Whereas in *Chlorochroa* and *Thyanta* the pits are round and rather deep, much like the so-called "punctures" on certain parts of many of the nymphs and adults, those on the eggs of *Acrosternum* are irregularly angular in shape, the chorion lacks pigment and the chorionic processes are numerous and strongly clavate, being attached by only a slender pedestal. While the pits of the chorion of the eggs of *Brochymena* are puncture-like, they are so arranged as to suggest some sort of parallelism with the primary spines on such eggs as those of *Euschistus*, but there seems to be no further relationship with the other pitted eggs. The assigned position of *Brochymena* in another tribe (Halyini) is probably justified.

The matter of reticulation of the chorion also seems worthy of some discussion. To a considerable degree it seems to be tied up with the presence of spines. Indeed, in most instances the reticulation consists of thick-set rows of spines. Only in *Mormidea* has there been found to be an actual raised network, although all those in this category seem to have such until seen under the compound microscope. In *Neottiglossa* the reticulated effect is produced by rows of mushroom-like bodies whose dilated distal ends are contiguous and conceal their points of origin. They would seem to be homologous with the spines on the eggs of such genera as *Euschistus* and *Coenus*.

In *Trichopepla* the spines are webbed together and the basic nature of the reticulation is obscured. The eggs of *Murgantia* have a very finely reticulated appearance but there are no spines and the reticulation seems to be beneath the surface, which would seem to remove it from this category. This is also supported by the peculiarity of the chorionic processes. These are so minute as to suggest that they may have become vestigial, thus indicating a position near the top of the phylogenetic tree. *Menecles*, too, seems to occupy a unique position, it has spines but no trace of reticulation.

In quite another category we find *Cosmopepla* and *Solubea*, whose chorion is essentially devoid of sclupturing or spines. Here, however, the similarity ends. *Cosmopepla* has comparatively few processes, those of the conventional type, and the operculum is very ordinary except for the lack of ornamentation. In *Solubea* the chorionic processes are not only the most numerous of any of the genera studied, but also the largest, thus forming a practically contiguous ring. The operculum, too, is radically different, being almost perfectly flat and occupying the entire anterior end of the egg. This seems to be about the ultimate in everything. Is it the beginning or the end in evolutionary development? It certainly seems to have no near relatives.

KEY TO THE KNOWN EGGS OF PENTATOMIDAE

1. Chorion reticulated 2
   Chorion not reticulated 9
2. Spines webbed together by a serous membrane 3
   Spines not webbed together 4
3. Processes long, equal to radius of operculum ..... **Podisus**
   Processes short, 3 or 4 times as long as thick ..... **Trichopepla**
4. Chorion transparent or whitish 5
   Chorion opaque, or at least not whitish 8
5. Eggs larger, mostly more than 0.95 mm. long 6
   Eggs smaller, mostly less than 0.80 mm. long 7
6. Form kettle-shaped, base more convex than operculum ..... **Euschistus**
   Form ellipsoidal, ends of equal curvature ..... **Coenus**
7. Form ellipsoidal, spines hairlike ..... **Mormidea**
   Maximum diameter usually below middle, spines coarse ..... **Hymenarcys**
8. Egg spinose, operculum rather flat ..... **Peribalus**
   Egg not spinose, operculum very convex ..... **Neottiglossa**
9. Eggs spinose ..... **Menecles**
   Eggs not spinose 10
10. Processes less than 40 in number 11
    Processes 45 or more in number 17
11. Chorion pitted 12
    Chorion not pitted 14
12. Form obovate, no banded colors ..... **Brochymena**
    Form subcylindrical, banded colors in fresh material 13
13. Processes clavate, inserted on elevated white ring ..... **Chlorochroa**
    Processes not dilated at end, no white ring as above ..... **Thyanta**
14. Eggs banded with black 15
    Eggs of solid color 16
15. Black bands remote from ends, chorionic processes minute ..... **Murgantia**
    Black bands at base and shoulder, processes plainly visible ..... **Apateticus**
16. Eggs black, operculum crested ..... **Perillus**
    Eggs yellow, operculum unadorned ..... **Cosmopepla**
17. Chorion pitted, operculum with moderate curvature ..... **Acrosternum**
    Chorion not pitted, operculum virtually flat ..... **Solubea**

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A REVISION OF THE SPHAEROPHTHALMINE MUTILLIDAE OF AMERICA NORTH OF MEXICO

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This revisionary paper is the result of study of over thirty thousand specimens of Photopsidinae Mutillidae, including all but a few of the types. In view of its length, it has been divided into a number of sections, each of which will deal with one group.

Our knowledge of the group, as it is in the literature, is very incomplete. Perhaps less than one-half of the North American species have been described. Most of those that have been described have been so briefly characterized that correct determination is practically impossible. The existing keys, utilizing largely superficial characters of no or little phylogenetic value, make determination of the described species a matter of chance. For these reasons, brief characterizations of the described species, based on the type, giving the salient characters that have been omitted in the original descriptions are given. For a description of the color characters and other superficial characters, the student is referred to the original diagnoses.

Since many species probably still await description, and since the status of the described forms is often largely a matter of conjecture, above all, since the males and females have been correlated in but a very few cases, a monographic study of the group is out of the question at this time. However, in the present treatment, an entirely different classification of the group is adopted, whose ramifications will be discussed in the second part of this paper, and some attempt has been made to arrange the groups phylogenetically. There are still many points regarding the relationships of and within the group that have to be settled, and no final, lasting classification of the genera can be attempted until the males and females have been correlated. It is to be hoped that this study, making determination of the species possible, will stimulate enough collecting and field observation, that sufficient material and enough data will accumulate to make correlation of the sexes possible.

Discussion of the taxonomy of the group, and keys to the genera and subgenera will follow in the next paper in this series.

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Genus **Protophotopsis** n. gen.

In working over extensive collections of the nocturnal Photopsidine Mutillidae, several specimens of a diurnal black, male Mutillid wasp were found. These specimens, representing an undoubtedly discrete new genus and species, are of interest in that they appear to represent a species of a relict genus, standing near the stock, or ancestral form, of the round-eyed New World Mutillidae. In its several primitive characters it approaches the hypothetical ancestral form, perhaps an invasion from the Old World, from which have evolved our largely nocturnal genera (*Photopsis*, *Sphaerophthalma*, etc.) on one hand, and several distinct lines of diurnal genera (*Pseudomethoca*, *Lomachaeta*, *Hoplomutilla*, *Dasymutilla*, etc.), on the other hand. The genitalia of the present genus are very generalized, as can be seen by inspection of the figure, and differentiate it from all other Photopsidine wasps. In fact, in the general facies of the genitalia (digitus vosellaris longer than cuspis) it approaches nearer *Pseudomethoca* than the Photopsidines.

The lack of complete parapsidal furrows, short flagella, with the articles largely broader than long, long felt lines of the second sternite, nodose petiole, close, even sculpture, small ocelli, lack of plumose hairs, convex, poorly developed clypeal region, all indicate that we are dealing with a relatively generalized form. The genus is side-wise specialized, however, in regard to the prominent hyaline setae of the apices of the abdominal segments, which serve to adequately differentiate it from all other Mutillid genera known to me, except only the entirely unrelated *Rhopalomutilla*, which may have similarly, but less prominently developed setae.

Male: Head subquadrate, its width considerably less than that of the thorax, rather well-developed behind the eyes (length behind eyes considerably greater than length of eyes); mandibles obliquely tridentate apically, rather broad, carinate basally on dorsal margin, entire beneath, neither emarginate nor dentate; eyes subovate in outline, strongly convex, moderately large, distinctly facetted; clypeus convex, weakly developed, not produced anteriorly; antennal scrobes with a glabrous oblique tooth or ridge above; antennal tubercles prominent, not approximate; scape a sixth longer than the pedicel plus first two flagellar segments, with a strong, sharp carina running its entire length below; pedicel and first flagellar segments short, transverse, subequal in length, scarcely more than half as long as the elongate second flagellar segment; ocelli small, the maximum diameter of the posterior less than a fifth their distance from the eyes; punctures of head very close to confluent, moderately large, but not very coarse, deep, with well-defined narrow

intervals. *Thorax* evenly, closely punctured, with the pronotum provided with epaulets (a pair of micropunctate areas, somewhat depressed, bearing a rather prominent tuft of very fine silvery hairs, located somewhat mesad and apicad of the humeri); mesonotum without a trace of parapsidal furrows; mesopleura evenly swollen, not evidently obliquely sulcate and divided into a dorsal and ventral region; mesosterna unarmed; metapleura with the dorsal depression on each side very marked, pit-like; tegulae small, convex, lacking any recurved or reflexed margin; propodeum evenly convex and closely coarsely punctured, not reticulated. *Abdomen* with the petiole considerably widened to apex (about two and one-fourth as wide at apex as at base), but moderately elongate (longer than wide apically), distinctly petiolate and nodose, the apical constriction of the tergite very marked, and the second tergite considerably narrowed to receive it; tergites one to five and sternites two to five each with a prominent subapical row of hyaline, colorless, curved, aciculate setae; the pubescence simple, sparse, erect; well-developed felt lines present on second sternite as well as on second tergite; puncturation of abdomen close, moderately coarse, deep. *Legs* with the paired white calcaria; the tibiae with the dorsal spines in apparently three rows of four or five to seven slender setae; tarsi with a weakly developed apical row of setae on each segment, but totally lacking any ventral rows of setae or spines. *Wings* with cell R_1+R_2 less than half as wide as cell M_4, less than two-fifths its area, not more than three-fifths its length; cell 2nd R_1+R_2 acuminate apically, nearly three times as long as high; distance between origin of free part of vein M and the stigma scarcely over half the length of the stigma; free part of vein M one-third as long as m-cu; free part of M_{1+2} one-third as long as free part of M_{3+4}; veins M_{1+2} beyond R_5, M_1 and M_2, and R_4 absent, or weakly indicated as color lines; cells R_5 and 1st M_2 thus not delimited; M_2 and m indicated as a color line.

Female: Unknown.

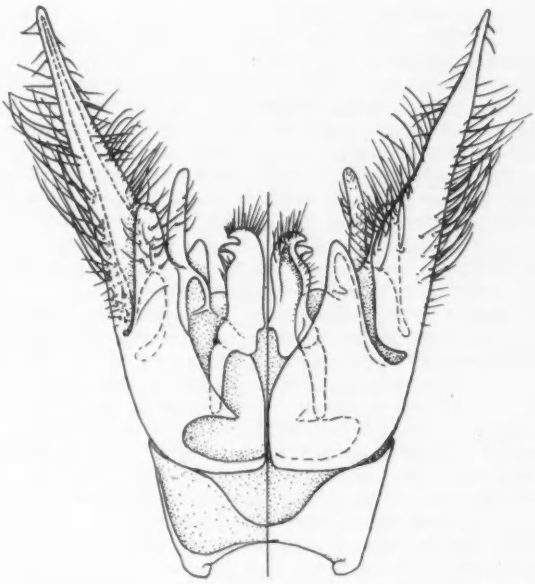
Genotype: Protophotopsis scudderi, sp. n.

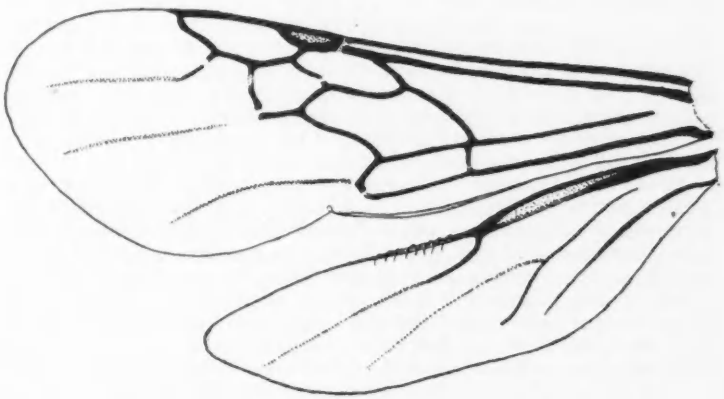
Protophotopsis scudderi, sp. n.

Male: Length 6.2 mm. Entirely black, with moderate, rather sparse evenly distributed erect silvery pubescence (except that of the notum of the thorax, and vertex of the head, and the apical tergites in large part infuscated); body evenly, densely, scarcely coarsely punctured.

Head subquadrate-rounded, its width slightly less than width of thorax at tegulae, well-developed behind eyes, closely, in part subconfluently punctured, rounded behind, the gula and genae and posterolateral angles not carinate. Mandibles and clypeus as in generic diagnosis, the latter distinctly punctured. Antenna short, none of the segments, except the scape and apical segment, more than a fourth longer than wide, the pedicel and first flagellar segments subequal, short, transverse; scape strongly, acutely, longitudinally carinate beneath, the rest of its surface densely hirsute and punctate. The eyes subovate, about a tenth longer than high, distinctly facetted, moderately large, quite convex. Ocelli very small, scarcely evident.

Thorax black, with rounded humeral angles, the pronotum rounded





Protophotopsis scudderi. Fig. 1. Genitalia of paratype. Fig. 2. Wing venation (color lines indicated by dotted lines; heavily pigmented areas stippled).

into the side pieces, coarsely, closely punctured. Humeral epaulets distinct, a similar tuft of fine hairs on the side pieces of the pronotum on each side, near its posterior margins. Mesonotum convex, closely punctate, lacking parapsidal furrows; the swollen mesopleura evenly convex, lacking an oblique sulcus (i.e., not divided into dorso-anterior and ventro-posterior halves). Tegulae scale-like, small, evenly convex, polished on disk, the edges hirsute and punctate. Scutellum somewhat swollen medially, hardly gibbous, with large punctures (similar in size to those of mesonotum) on the central area, separated by polished intervals; the lateral areas on each side depressed, with some fine silvery pubescence. Metanotum medially nearly continuous with both scutellum and propodeum, and there with some coarse punctures separated by polished intervals; laterally depressed, very closely punctulate, with dense silvery appressed, fine hairs. Metapleura coarsely and irregularly punctured below, glabrous above and channeled, ending in a deep pit-like depression. Propodeum evenly rounded, closely, coarsely, but rather shallowly punctate, locally nearly reticulate, the punctures coarser than those of thorax; dorso-medially also with some scattered punctulations, bearing sparse silvery, decumbent hairs. Legs black, partly dark mahogany or dark piceous, with moderate silvery pubescence and white calcaria. Wings weakly infuscated, with dark brown veins and stigma, the venation as in the generic diagnosis.

Abdomen closely punctured, the apical sternites (except hypopygium) noticeably less coarsely so. Petiole as in generic diagnosis, ventrally coarsely, rather closely punctured, convex, anteriorly strongly laterally compressed and thus produced as a subdentiform, anteriorly directed, punctate ridge; not at all carinate ventrally. Tergites 1–5 and sternites 2–5 each with a distinct row of decumbent, apically twisted or bent setae, in addition to the sparse erect pubescence. Second tergite and sternite with silvery felt-lines, those of the sternites scarcely one-third the length of the segment, situated opposite the posterior half of those of the second tergite; thus not much over half as long as the latter. Second sternite not at all flattened, distinctly convex. Apical tergites closely, coarsely punctured, including the strongly convex last tergite, which has a narrow lateral and posterior margin that is nearly reflexed. Hypopygium coarsely, rather sparsely punctured, flat, the truncate anterior margin nearly impunctate and polished, however; basally, medially strongly depressed to form a transverse pit-like area at its juncture with the seventh sternite.

Genitalia: Parameres thick, cylindrical-tapering, heavy at base; basal section with long, strong setose hairs on the outer-lower face, the inner edges with much finer, but still rather long, equally dense vestiture. Aedeagus rather slender, at apex with two strong, sharp teeth, downward turned; at base ending in long slender falcate apodemes. Digitus volsellaris finger-like, cylindrical, about two-thirds longer than the short, more or less conical lobe-like cuspis volsellaris; the digitus not more than two-fifths the length of the parameres, however. Dorsal parameral plate ending in an obliquely truncate apical lobe on each side.

Holotype: Fedor, Lee Co., Texas, May 29, 1902 (Birkman), in the collection of the Museum of Comparative Zoology. Two paratopotypes, with the same data, one in the collection of the Museum of Comparative

Zoology, one in the author's collection. One paratype, Regnier, Colorado, June 6–8, 1919 (about 37 degrees north, 102 degrees, 50 seconds west, and 4500 feet altitude), in the collection of the American Museum of Natural History; one paratype, Cotulla, Texas, April 5, 1906 (F. C. Pratt), in collection of United States National Museum.

The genitalia ally this genus with the Pseudomethocine wasps in some ways, as can be seen by referring to the figures given by Mickel (Proc. U. S. Nat. Mus., 64: (Art. 15), pls. 1–4, 1924) but in the present genus the aedeagus appears to be better developed, the digitus (sagitta) is comparatively better developed, compared with the cuspis (volsella), nor are the two ever fused at base, as the drawings of Mickel indicate to be the case in *Pseudomethoca*. The general facies of the genitalia, as well as the similarity in shape of the cuspis volsellaris and the parameres indicates that this genus is perhaps allied to the primitive species of *Pseudomethoca*. *Sphaerophthalma* and its allies, can at once be told from both these genera by the fact that the cuspis is always distinctly longer than the digitus, and by the primitively slenderer parameres.

RELATIONSHIP WITH OTHER GENERA

The genus *Protophotopsis* combines a number of primitive characteristics, occurring in both *Sphaerophthalma* and its allied supraspecific groups, on one hand, and in *Pseudomethoca*, *Lomachaeta*, and *Dasymutilla*, on the other hand. The small ocelli, short flagellum, lack of plumose hairs, general structure of the genitalia suggest a distinct relationship with the latter group of genera. The total absence of any ventral mandibular excision or tooth, which is certainly to be interpreted as a secondary condition, allies it to our other diurnal Mutillid genera, except *Lomachaeta*, which in the ventral emargination of the mandibles occupies a very isolated position, as regards the Dasymutilline-Pseudomethocine complex of genera; the total absence of parapsidal furrows also allies *Protophotopsis* to the diurnal complex of genera. From all of these it differs strikingly in the well-developed felt lines of the second abdominal sternite, which ally it to the Sphaerophthalmine wasps. We are dealing here, however, with possibly isolated retention of a very primitive characteristic—the ventral felt lines—while there has been much divergence in other characters. The form of the petiole, the sculpture, the erect vestiture, mostly silvery and sparse, all give the genus a distinct resemblance to the Sphaerophthalmines—at least to the more primitive forms with close sculpture that lack plumose hairs and have very short, incomplete parapsidal furrows.

It is thus apparent that we are dealing with a relict genus here, that has independently retained the felt lines of the second sternite—a characteristic it shares only with the Sphaerophthalmines, with *Pseudophotopsis*, and with a very few other of the genera with small tegulae and round or oval, non-emarginate eyes. The fact that a single species is known, and that the genus will certainly consist of no more than a very few species, when fully known, also indicates that we are dealing with a relict, isolated generic type, evidently not very successful and apparently not very able to compete with other groups today.

The possession of ventral felt lines places the genus in a position somewhat near the base of the Dasymutilline-Pseudomethocine develop-

mental lines, as well as somewhat near the Sphaerophthalmine line of development. The fact that in its lack of specialization towards a nocturnal condition *Protophotopsis* is more generalized than the Sphaerophthalmines has been the cause for selecting the present name. At the same time a direct ancestral relationship to the Sphaerophthalmines is not implied: the writer simply wishes to indicate that in many of its characters the new generic type lies close to the ancestral type of *Sphaerophthalma* and *Photopsis* and the rest of that complex. In the loss of all trace of a ventral mandibular excision *Protophotopsis* must certainly be regarded as more specialized than the Sphaerophthalmines.

Protophotopsis differs from all of the North American genera in the possession of distinct, hyaline, colorless curled setae, occurring in regular rows, one per abdominal segment. The setae are very similar to those found in some *Tiphiidae* (*Paratiphia*) and to those occurring in *Rhopalomutilla* (or at least some species of that genus). In the possession of subapical rows of setae of the abdominal tergites and sternites the present genus agrees with *Lomachaeta* Mickel. It differs from *Lomachaeta* entirely in the nature of these setae, as well as in other significant characters.

Mickel, in his original diagnosis of *Lomachaeta* (Annals Ent. Soc. Amer., Vol. 29, p. 289, 1936) says that this genus is "related to *Dasymutilla* and *Pseudomethoca*"; examination of two males and a single female, kindly loaned by Dr. Mickel, also brings out the fact that there is some relationship to the Sphaerophthalmines, though less close. The original generic diagnosis of *Lomachaeta* only brings out the following differences from *Protophotopsis: Lomachaeta* has the mandibles emarginate below, *Protophotopsis* has them entire; eyes subovate in *Lomachaeta*, nearly circular in *Protophotopsis;* felt lines of second sternite absent in *Lomachaeta*, well-developed in *Protophotopsis;* stigma of fore-wings of *Lomachaeta* much reduced, well-developed in *Protophotopsis*.

In view of the brevity of the original diagnosis of *Lomachaeta*, it thus seems worth-while to indicate what additional differences there exist between the two genera, which are not at all closely related, and to stress certain other generic characters of *Lomachaeta* not brought out in the original description.

The female of *Lomachaeta* is strikingly different from other related genera in that the head is nearly globose; the very coarse sculpture and reticulation of the dorsum of the head and thorax are different from all other North American forms except that those of certain Sphaerophthalmines; the shape of the petiole also is quite similar to that found in some Sphaerophthalmine males and females. A somewhat indefinite indication of a suture, immediately anterior to the metathoracic tubercles bearing the spiracles, as seen in the allotype of *L. hicksi*, appears to be primitive, and differentiates it from the Sphaerophthalmines. The shape of the thorax (elongate-obpyriform) is similar to that of some females of *Sphaerophthalma*.

The males examined (paratypes of *L. hicksi* and *coloradensis*) also have the head quite inflated, but dorsoventrally so, the head looming far above the eyes, as seen from a lateral view; seen from above, the head is quite transverse, and the temples are not at all full; the head is extremely short behind the eyes, the length of the vertex behind the

eyes being less than a fourth the length of the prominent eyes. The eyes are very large, oval-hemispherical (much more prominent than in *Protophotopsis*). In *Protophotopsis*, on the other hand, the head is much fuller in the temples, and transverse-rectangular in dorsal outline; the vertex behind the eyes is longer than the length of the eye; the head is not evidently swollen. The sculpture of the head in *Lomachaeta* males varies from rather distant and very coarse to rather close to confluent and very coarse; in both cases the punctures are not sharply defined; in *Protophotopsis* the punctures are small, regularly and evenly distributed, close, and well-defined.

The thorax of both genera agrees in that the parapsidal furrows of the mesonotum are absent; a fact not brought out in the original diagnosis of *Lomachaeta*. Both genera agree with the other, more or less closely related genera in the group (*Photopsis*, *Sphaerophthalma*, *Pseudomethoca*, *Dasymutilla*) in that the anterodorsal margin of the pronotum has a tuft of fine, backward decumbent, silvery hairs, slightly mesad of the humeral angles; these I term the "*epaulets*." The epaulets appear to be of great significance in the taxonomy of the group; the position of similar areas, near the dorso-posterior corners of the side pieces of the prothorax in some groups (notably some species of *Photopsis* and *Dasymutilla*) is significant. The form, number and position of the epaulets separate the North American round-eyed Mutillidae (except Myrmilloides) from the *Pseudophotopsidinae*, which have depressed areas bearing fine hairs near the lower edge of the side-pieces of the prothorax, and from numerous other Old World genera of *Mutillinae*, that lack them.

The petiole of *Protophotopsis* is much more elongate and strongly nodose, by comparison to the shorter, subsessile petiole of *Lomachaeta;* the latter has the petiole small, not strongly convex, and separated by a very slight constriction from the second tergite. The setae occurring at the apices of the abdominal segments of *Protophotopsis* are entirely different in nature from the hairs occurring just basad of them, and do not intergrade with them; they are furthermore hyaline, twisted, apicad-directed, and decurved or curled under at the tips. In *Lomachaeta*, on the other hand, the setae are clearly derived from hairs; they are black, directed mesad, nearly straight except that their insertion is oblique and they are down curved basally, but straight apically; they are much larger on tergites 2–3 than those of *Protophotopsis*, but on the apical tergites and on all the sternites are scarcely distinct in size from the regular hairs, and differ from them only in being decumbent. The regular rows, of both tergite and sternite, of hyaline apical setae, directed backward, of *Protophotopsis* thus cannot be compared to the sparser, opaque, black setae of *Lomachaeta* that decrease in size as one approaches the lateral margins of the tergites, are directed mesad, and form a distinct V medially; the derivation of these setae from regular hairs is perfectly apparent on the ventral segments, and on the apical tergites.

The sculpture of the abdomen of *Lomachaeta*, especially of segments one and two, is very sparse, very coarse, and consists of poorly defined punctures; the abdomen of *Protophotopsis*, like the rest of the body, is closely, regularly, finely punctured.

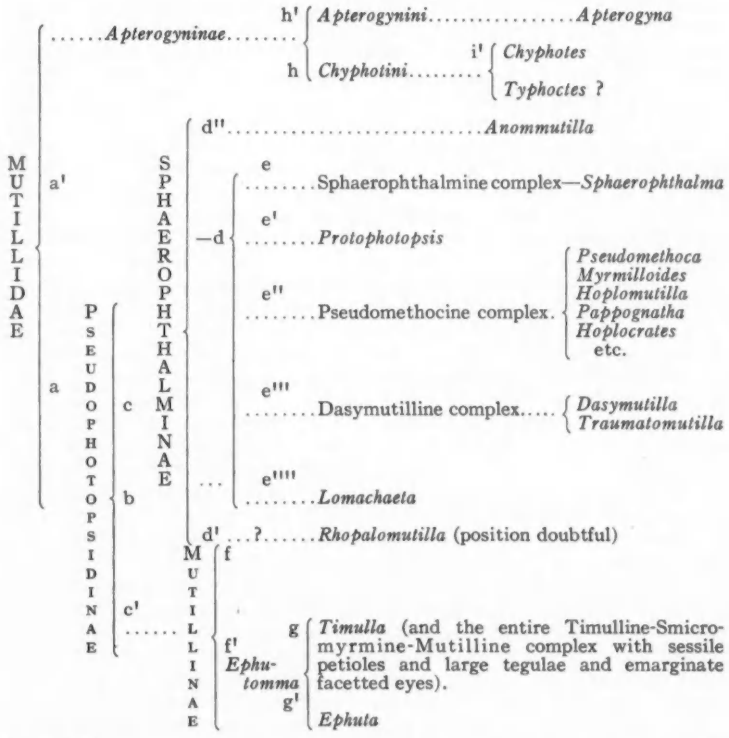
THE POSITION OF THE GENUS AND ARRANGEMENT OF THE NEW WORLD MUTILLIDAE[1]

The neogaeic Mutillidae may be tentatively arranged as in the following table. This arrangement leaves most of the Old World types out of consideration (unless they have a direct bearing on the classification of our genera). The position of these groups will be more fully treated in a separate contribution, in which the comparative morphology of the genitalia will be discussed.

The above relationship may be outlined as follows, in accordance with the lettering used in the following table:

TABLE A

RELATIONSHIP OF SOME OF THE CHIEF MUTILLID TYPES, AND OF THE NEW WORLD GENERA[2]



[1]There has been no general attempt at a classification of the Mutillidae since the disastrous attempt by Ashmead (1903–1904) and the scarcely more satisfactory arrangement by Andre (1903), excepting only the regional classifications of Bradley (1916) and Bischoff (1920). Since there is no accepted classification of the

Mutillidae.—Primitively with felt lines of both second tergite and sternite; mandibles primitively ventrally excised; tegulae primitively small, subcircular, impunctate, not reaching beyond mesonotum; parapsidal furrows primitively absent or incomplete; tarsal claws primitively armed with a tooth within; anal lobe of hind wings primitively present. Female primitively wingless, with the pro-mesothoracic suture distinct, and with distinct ocelli; tarsal claws armed.

a. Petiole formed by both tergite and sternite, the tergite extending to base of segment; ocelli of female retained; pro-mesothoracic suture of female retained; anal lobe of male retained; aculeus of hypopygium not present in male; long felt lines of both tergite and sternite retained, at least in male; male with extensive depressed, densely felted area at lower angles of side-pieces of thorax. (*Male retains tooth on inner side of tarsal claw*),
Pseudophotopsidinae (including only **Pseudophotopsis**)

b. Tooth of tarsal claws lost in male; anal lobe of male hind-wings lost; extensive felt-like area (epaulets) of lower angle of side pieces of male prothorax lost (or never developed).

c. Petiole remains primitively slender, petiolate; eyes with emargination not developed as a sharp notch (except for *Rhopalomutilla*, which may belong elsewhere); tegulae never becoming large and conchiform, remaining rounded and small; eyes usually losing strongly developed facettation,
Sphaerophthalminae

d. Eyes totally losing any indication of a notch of inner orbits; middle tibiae retain two calcaria; antennal tubercles retained; felt lines not totally lost.

e. Felt lines of sternite two of abdomen primitively retained; petiole except secondarily) remains more or less nodose; antennal scrobes develop a small tooth or tubercle in male; parapsidal furrows more or less distinct; plumose hairs generally developed; largely nocturnal; ventral mandibular excision retained,
Sphaerophthalmine complex (**Sphaerophthalma**)

e'. Felt lines of sternite two retained; parapsidal furrows absent; hyaline curled setae developed on abdomen; petiole remains nodose; ventral mandibular excision lost; no scrobal tooth; diurnal; antennae short, first flagellar transverse.....**Protophotopsis** n. g.

e''. Felt lines of sternite two lost; petiole becomes sessile; parapsidal furrows absent (generally); mandibular excision lost; antennal scrobes carinate but not toothed, occasionally not carinate; no special vestiture developed on abdomen (but with tendency to develop spatulate hairs); head usually large and quadrate, with well-developed tendency to develop gular and hypostomal processes; antennae not with first flagellar transverse, short,
Pseudomethocine complex.
(**Pseudomethoca, Myrmilloides, Hoplocrates, Pappognatha, Hoplomutilla, Tilluma, Attilum, Euspinolia,** etc.).

e'''. Felt lines of second sternite lost; petiole remains slender, more or less petiolate; parapsidal furrows absent; mandicular excision lost; antennal scrobes of male not defined above; never with special

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family the following is proposed as a tentative arrangement, for the criticism of the co-workers on the group. The use of the presence of an inner tooth of the tarsal claws, or its absence, the nature of the epaulets, or their absence, and several other characters represent innovations; these have thrown further light on relationships within the group, which, together with the accumulated perspective of the last generation make a new attempt at a classification of some value. More emphasis on the nature and development of the felt lines, the ventral mandibular tooth, the tegula size, development of anal lobes of the wings, and the eye-shape also result in an entirely different arrangement than heretofore given.

[2]This table utilizes a number of new concepts in the relationships existing within the family; these concepts will be discussed at greater length and in more detail in a separate forthcoming paper.

vestiture anywhere; head not becoming large and quadrate, no tendency for ventral processes or carinae; antennae with first flagellar not transverse,

Dasymutilline complex, (**Dasymutilla, Traumatomutilla**)

e''''. Felt lines of second sternite lost; petiole remains slender, petiolate; parapsidal furrows absent; mandibular excision retained; antennal scrobes not defined above; with development of unique abdominal stiff bristles; head not becoming large, more or less globose; no tendency for ventral processes or carinae; first flagellar segment like pedicel, transverse.....**Lomachaeta**

d'. Eyes develop a deep notch, but petiole stays slender, nodose in male; tegulae small; felt lines totally lost in both sexes; antennal tubercles normal; middle tibiae retain two calcars (Exotic),

Rhopalomutilla (position doubtful)

d''. Eyes reniform-oval, as is *Pseudophotopsis*, shallowly and broadly emarginate on inner orbits; antennal tubercles become obsolete; one calcar of middle tibiae lost; felt lines of second sternite lost; petiole slender; tegulae small,

Anommutilla (position doubtful, perhaps belonging in separate family)

c'. Tegulae becoming large, more or less conchiform or expanded, often with slightly revolute edges, reaching to or beyond apex of mesonotum; petiole becoming broad and sessile, transverse; eyes always with strong facettation, ovate or reniform, sharply notched within..**Mutillinae** (s. str.)[3]

(f. Petiole slender, nodose; felt lines entirely lost; tegulae small; female loses all trace of ocelli and dorsal sutures of thorax; felt lines lost,

Rhopalomutilla (position doubtful, in all probability in or near *Sphaerophthalminae*).

f'. Petiole stout, broad, strongly dilated (in the single isolated genus *Ephuta* secondarily becoming small, but there cylindrical and not nodose); felt lines of both tergite and sternite retained; tegulae very large; female retains pro-mesothoracic suture and to a lesser degree the metathoracic-propodeal suture) and ocelli; at least second tergite retains some indication of felt lines, in some species of all genera...**Mutillinae:** the archaic genus **Ephutomma** (exotic; ancestral to the following two types).[4]

g. Petiole remains strongly dilated and sessile; felt lines of second sternite primitively retained, those of second tergite unmodified; male with abdominal tergites not longitudinally, medially

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[3]The separation into two basic developmental lines, based on tegula size and essential petiole shape, is believed to be fundamental. Correlated with these characters is the nature of the eye, which is always distinctly facetted, more or less ovate to reniform in shape in the Mutillinae. Whether these two developmental lines, each of which includes several tribes, or generic complexes, should be given subfamily rank is very doubtful. The name *Photopsidinae* could be used for the round-eyed complex with small tegulae were it not for the fact that *Photopsis* is not generically distinct from *Sphaerophthalma* as will be shown elsewhere. This matter will be discussed at greater length in a future contribution.

[4]Bischoff (1920, p. 23) indicates that *Ephutomma* possesses an anal lobe in the male sex; he furthermore (p. 95) stresses the existence of exceedingly close relationship between the latter genus and *Pseudophotopsis*, and states: "Es wäre . . . zu erwägen, ob man nicht die Gattung *Ephutomma* besser also Untergattung zu *Pseudophotopsis* stellen würde. . . . " I do not find that there is any such close relationship between the two genera in question. The absence of an inner tooth of the tarsal claws in *Ephutomma*, the absence of any anal lobe in the male of that genus, as well as the large tegulae, more strongly notched eyes, and decidedly more strongly dilated, not subsessile or subpetiolate first abdominal segment indicates that there is no close relationship, except for such as is inherent in both genera as regards retention of many primitive characteristics. How Bischoff arrived at the idea that *Ephutomma* has an anal lobe in the hind wing is inexplicable, unless, indeed, he has mistakenly included a species of *Pseudophotopsis* in *Ephutomma*, and based his key on this; however, he does not mention the existence of an anal lobe in his generic diagnosis of *Ephutomma* (o. c., pp. 146–148).

carinate. (Ocelli and all dorsal thoracic sutures of female lost), Tribe Mutillini[5]

g'. Petiole becomes subterete, much narrower than second segment, subcylindrical; felt lines lost (except for a retention of a modified felt line, in the form of a pit, in some species, on tergite two); male with abdominal tergites 5–7 at least longitudinally carinate. (Ocelli and all dorsal thoracic sutures of female lost.), Tribe **Ephutini (Ephuta)**

a'. First tergite reduced, absent anteriorly, the anterior part of the petiole formed by sternite one alone; ocelli of female lost; pro-mesothoracic suture of female retained throughout; anal lobe of male hind wings retained throughout; hypopygium of male always armed with an aculeus; felt lines strongly reduced to a small tuft in both male and female, on second tergite; male in all forms retains a distinct tooth of the inner side of the tarsal claws; epaulets lost; male lacks parapsidal furrows; ventral mandibular excision and tooth never developed (or lost) ..... Subfamily **Apterogyninae**

h. Wing venation not extremely reduced; second abdominal segment not strongly constricted at apex, Tribe **Chyphotini (Chyphotes)**

h'. Wing venation extremely reduced, limited to basal third of wings; second abdominal segment strongly constricted at apex in both sexes, Tribe **Apterogynini (Apterogyna,** exotic)

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[5]Bischoff (1920, p. 23) recognizes three tribes here, the *Mutillini*, *Trogaspidini*, and *Smicromyrmini*. It is the writer's belief that the extreme abundance of closely allied types in these groups led Bischoff to attempt a separation here simply because the extreme development of this line in Africa made a separation of some sort desirable, purely as a matter of convenience; no such separation is at all warranted, and the tribal characteristics employed by Bischoff are in part not even of generic value, vide Bradley and Bequart, 1923.

THE LONG-HORNED BEETLES OF OHIO (COLEOPTERA: CERAMBYCIDAE), by Josef N. Knull. Ohio Biol. Surv. Bull. 39, vol. 7, No. 4, pp. 133–354, Pls. 1–28. Ohio State University Studies. Columbus, Ohio, 1946. Price, $1.00.

This work should be at the right hand of everyone who is interested in Coleoptera or who has occasion to identify Cerambycidae from Ohio or the surrounding states. It includes keys and descriptions of 262 species falling in 112 genera, of 46 tribes of the 6 subfamilies of North American Cerambycidae. Included are species known to occur in Ohio as well as many that are likely to occur. As a result of the geographical location of Ohio, its utility extends far beyond the bounds of the state. The descriptions are concise and comparative, designed for a maximum of usefulness. The synonymical bibliographies are presented in a somewhat unorthodox manner but the references cited, in general, include those which are most useful in understanding the species. The terminal bibliography will prove helpful to students of the Cerambycides anywhere in North America.

The work is beautifully illustrated and the drawings, from the pen of Mr. Knull himself, are a most valuable and lasting feature of the publication. To those who have had the privilege of seeing the beautifully mounted and meticulously arranged personal collection of Mr. Knull, this should come as no surprise. His collection reveals the fact that he is an artist! The illustrations include 118 drawings and 2 plates of photographs. The drawings in a few cases involve anatomical details but mostly represent the whole insect. The author has so well caught the facies peculiar to the various species that the specialist can readily recognize them without reference to the explanation of plates. The publication will be useful not only to advanced students of the Cerambycidae but should be an invaluable asset to beginners and to those unfamiliar with the family.

—E. G. Linsley.

THE GENERIC AND SUBGENERIC NAMES OF JAPYGIDAE, WITH THEIR GENOTYPES[1]

WILLIAM F. RAPP, JR.,
Urbana, Illinois

The following list is presumed to be complete through 1945, but since the war has disrupted the distribution of scientific journals and the preparation of bibliographic periodicals, its completeness for the most recent literature may be questioned. The list comprises 21 names. In all cases the genotype species has been fixed in connection with the original publication of the name and, except for eight names, the original description of the genotype appears with the generic description.

Dr. Peter Wygodzinsky has been good enough to check this list, but any mistakes or errors are entirely the author's fault.

ALLURJAPYX Silvestri
Mem. Soc. Ent. Ital., vol. 9 (1930), p. 8.
Type: *Allurjapyx aethiopicus* Silvestri.

BURMJAPYX Silvestri.
Rec. Indian Mus., vol. 32 (1930), p. 483.
Type: *Japyx oudemansi* Parona.

CATAJAPYX Silvestri.
Boll. Lab. Zool. Portici, vol. 27 (1932), p. 95.
Type: *Japyx confusus* Silvestri.

DINJAPYX Silvestri.
Bollettino del Laboratorio di Zoologia Generale e Agraris, Portici, vol. 23 (1930), p. 232.
Type: *Dinjapyx barbatus* Silvestri.

ECTASJAPYX Silvestri.
Memorias de la Real Sociedad Espanola, vol. 15 (1929), p. 233.
Type: *Ectasjapyx bolivari* Silvestri.

EPIJAPYX Silvestri.
Boll. Lab. Zool. Portici, vol. 27 (1932), p. 105.
Type: *Japyx corcyraeus* Verhoeff.

EVALLJAPYX Silvestri.
Boll. Lab. Zool. Portici, vol. 5 (1910), pp. 75–76.
Type: *Evalljapyx sonoranus* Silvestri.

HEMIJAPYX Ewing.
Proc. Ent. Soc. Wash. 43 (1941), p. 69.
Genotype: *Hemijapyx unidentatus* Ewing.

HETEROJAPYX Verhoeff
Arch. Naturgesch, vol. 70 (1) (1903), p. 102.
Type: *Japyx novaezeelandie* Verhoeff.

INDJAPYX Silvestri.
Rec. Indian Mus., vol. 32 (1930), p. 451.
Type: *Japyx indicus* Oud.

JAPYGELLUS Silvestri.
Boll. di Zool. Gen. e Agr., vol. 23 (1929), pp. 194.
Type: *Japygellus serrifer* Silvestri.

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[1]Contribution No. 265 from the Department of Entomology, University of Illinois, Urbana.

JAPYGINUS Silvestri.
Boll. di Zool. Gen. e Agr., vol. 23, (1929), pp. 190–192.
Type: *Japyginus breviforceps* Silvestri.

JAPYX HALIDAY.
Trans. Linn. Soc. Lond., vol. 24 (1864), p. 442.
Type: *Japyx solifugus* Haliday.
Original spelling *Iapyx*.

MEGAJAPYX Verhoeff.
Arch. Naturgesch, vol. 70 (1) (1904), p. 101.
Type: *Japyx gigas* Brauer.

METAJAPYX Silvestri.
Boll. Lab. Zool. Portici, vol. 27 (1933), p. 82.
Type: *Japyx* (*Metajapyx*) *aemulans* Silvestri.
Considered by Silvestri as a subgenus.

MIOJAPYX Ewing.
Proc. Ent. Soc. Wash., 43 (1941): 69–75.
Type: *Miojapyx americanus* Ewing.

MIXOJAPYX Silvestri.
Boll. Lab. Zool. Portici, vol. 27 (1933), pp. 135.
Type: *Japyx saussurei* Humbert.

NEOJAPYX Silvestri.
Boll. Lab. Zool. Portici, vol. 27 (1933), p. 120.
Type: *Neojapyx guianae* Silvestri.

OPISTHJAPYX Silvestri.
Bul. Soc. Ent. France, 1929, p. 245.
Type: *Opisthjapyx seurati* Silvestri.

PARAJAPYX Silvestri.
Ann. Scoul. Agric. Portici, vol. 5 (1903), p. 6.
Type: *Japyx isabellae* Grassi.

PARINDJPAYX Silvestri.
Boll. Lab. Zool. Portici, vol. 27 (1932), p. 97.
Type: *Parindjapyx crivellarii* Silvestri.

BOOK NOTICE

THE INSECT FAUNA, REVISED, by WILLIAM PROCTER. Part VII. Biological Survey of the Mount Desert Region, Inc., founded and directed by William Procter. Map, 566 pp. and illustrations of habitats, 1946. Wistar Institute of Anat. and Biol., Philadelphia. Published for private distribution.

Part I, 1927, of the Biological Survey of the Mount Desert Region was written by C. W. Johnson, dipterist of the Boston Society of Natural History. Johnson and Procter were friends. At the time Procter was fully occupied with lists of marine fauna while Johnson, profiting by the long interest of New England entomologists in the remarkably rich fauna of Mount Desert Island, had at hand enough data to publish a first volume for Procter's Biological Survey. Parts II, III, IV and V were lists of the marine and related beach faunas of the island. Part VI, 1938, was a version by Procter of Part I on Insecta. Part VII is a revision and amplification of Parts I and VI with the addition of 1100 species and biological notes.

Because (1) of the extreme care taken in the exact identification of all species by dependable specialists, (2) of the many years of collecting over the hundred square miles of Mount Desert Island and, (3) because of the remarkable mixture of Arctic, Canadian and Atlantic Coastal plain species this list with many observations on habit, distribution and season on the wing is one of the most useful and valuable regional lists of insects we have. It covers an area much more northerly than the very useful Connecticut lists and one farther northeast than the New York State List. It is of special use to students of the insects of Maine, New Brunswick and Nova Scotia.

As pointed out by Procter in the introduction, the basis of the rich fauna appears to be the richness of the flora. The great specialist on the distribution of floral elements from the Carolinas to Labrador, Professor M. L. Fernald, Harvard Botanist, has written of the island's flora: "This extraordinary accumulation within one small area of the typical plants of the arctic realm, of the Canadian zone and in many cases of the southern costal plain cannot be duplicated at any point known to the writer". For years Mount Desert Island has been a favorite collecting place for New England entomologists. Thus the list is a summary not only of Procter's great collection at the Laboratory of the Survey but of material formerly in the Museum of the Boston Society of Natural History, in the Museum of Comparative Zoology of Harvard, the collections in the Massachusetts' State Agricultural College, Amherst, in the University of Maine at Orono and in several of the lesser New England institutions. The U. S. National Museum specialists have helped particularly on Hymenoptera. It thus becomes one of the most dependable lists of its size.

The richness of the flora and of the consequent insect fauna appears to be due to (1) the geographic location of this island at the juncture of three floral areas as mentioned, (2) the nearly constant level of a fairly high humidity due to the adjacent ocean and the moderate or cool temperatures, and (3) the very equitable temperature where records show a summer high of 78°F. and a winter low of only 5°F.

The leaders in the great eastern biological institutions know William Procter better than do the entomologists. Born into an international business but always interested in biology he has been a most valuable supporter of and advisor to various scientific institutions. He is a Trustee of the American Museum of Natural History, a member of the board of managers of the Wistar Institute and a member of the advisory board of the Department of Zoology of Columbia University. He was educated in biology at Yale, the Sorbonne (Paris), Columbia University and has the degree D. Sc. from the University of Montreal. He has been eminently successful in everything he has touched. He recognizes opportunities in biology as well as in business, and has the ability to develop such by sound plans and leadership. He has supported our Annals generously but better yet by sound advice and friendly letters to the editors has kept them from that despondency that is apparently one of the afflictions involved in editoral misadventures. Annals editors have been very grateful for his stimulating interest. It has lifted editorial work above grinding routine.—C. H. KENNEDY.

ERRATA

Page 191, Fig. 1. The cut is inverted, with the proximal ends of the elytra downward. As it stands the five figures should be numbered 1 to 5 from *right* to *left*.

Page 268, couplet 10. *Ormae* should be spelled *ormea*.

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March Number—March 29, 1946.

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